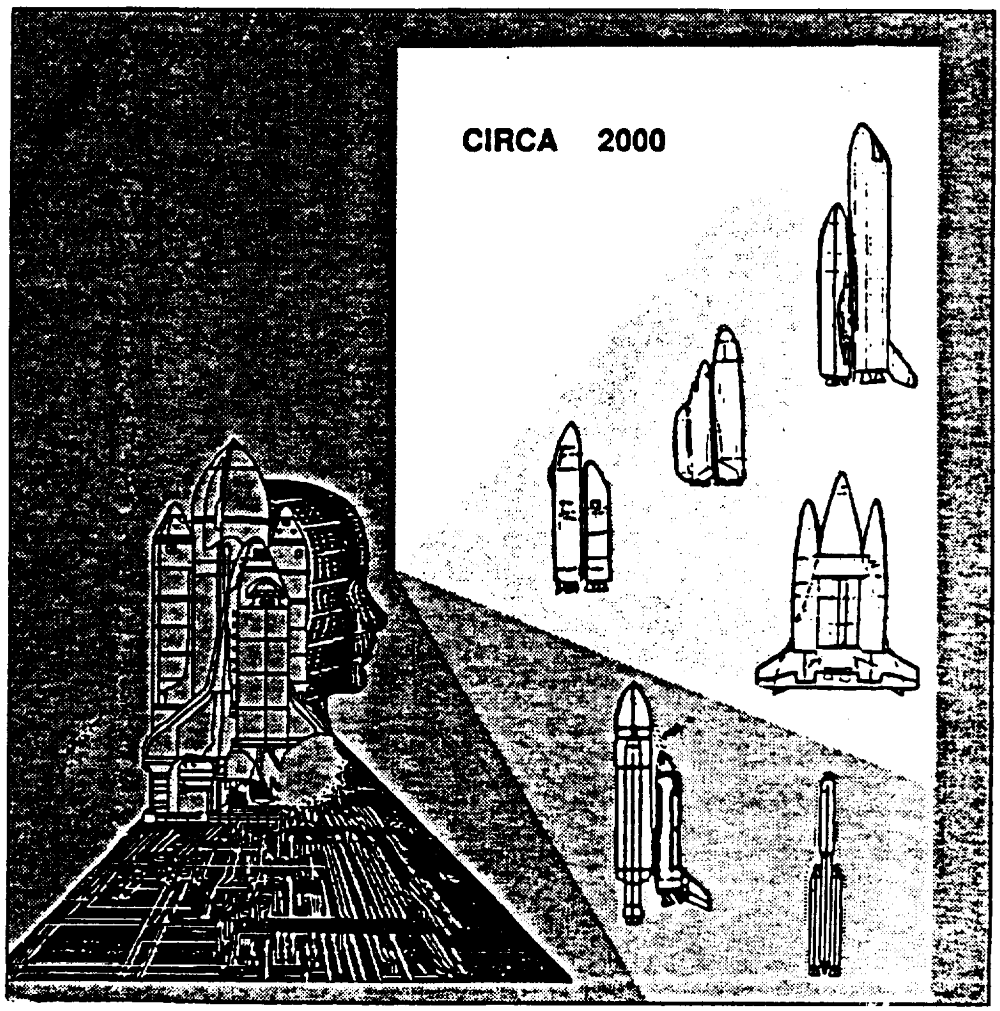
BOEING
AEROSPACE OPERATIONS, INC.

Shuttle Ground Operations Efficiencies/Technologies Study



SGOE/T . . . ALS Phase 2 Contractor Workshop
Data Reference Document

PHASE 3, VOLUME 3 OF 4

Simplified Launch System Operational Criteria

W. J. Dickinson
KSC Study Manager
(407) 867-7705

KENNEDY SPACE CENTER
NAS10-11344
March, 1989

A. L. Scholz
Boeing Study Manager
(407) 867-2334

TABLE OF CONTENTS

Simplified Launch System Operational Criteria

ACRONYMS and ABBREVIATIONS

$B	Dollars-billions
$M	Dollars-millions
AFD	Aft Flight Deck
AFSATCOM	Air Force Satellite Communications
AFSCF	Air Force Satellite Control Facility
AFSCN	Air Force Satellite Control Network
AFSCF/STC	Air Force Satellite Control Facility/Space Test Ctr.
AGCS	Automatic Ground Control System
AH	Ampere-Hour
AI	Artificial Intelligence
Al	Aluminum
Al-Li	Aluminum-Lithium
ALS	Advanced Launch System
AOA	Abort Once Around
APU	Auxiliary Power Unit
ASE	Airborne Support Equipment
ASSY	Assembly
ATC	Air Traffic Control
ATE	Automatic Test Equipment
ATKB	Automation Technology Knowledge Base
ATO	Abort to Orbit
ATPG	Automatic Test Program Generation
A50	Aerozine 50 (50% Hydrazine and 50% UDMH)
BAC	Boeing Aerospace Company (Seattle)
BAO	Boeing Aerospace Operations (KSC)
BIT	Built-In-Test
BITE	Built-In-Test-Equipment
BSTR	Booster
C	Celsius; Carbon
C2K	Circa 2000
C_3H_8	Propane
CAD	Computer Aided Design
CAE	Computer Aided Engineering
CAI	Computer Aided Instruction
CALS	Computer Aided Logistics System
CAM	Computer Aided Manufacturing
CCAFS	Cape Canaveral Air Force Station
CDDT	Countdown Demonstration Test
CDF	Confined Detonating Fuse
CECO	Center Engine Cutoff
CELV	Complimentary Expendable Launch Vehicle (now Titan IV)
CG	Center of Gravity
CH_4	Methane
CIM	Computer Integrated Manufacturing
CITE	Cargo Integration Test Equipment
CIU	Computer Interface Unit
CM	Command Module
C/O	Checkout
COMM	Communications
COMM SAT	Communication satellite
CPU	Central Processing Unit
CPV	Combined Pressure Vessel
CR	Control Room
Cryo	Cryogenic
CSOC	Consolidated Space Opertions Center
CT	Cravler Transporter
CTS	Common Tank Set
CV	Cargo Vehicle

ACRONYMS and ABBREVIATIONS
(Continued)

DA	Data Acquisition
D/A	Digital/Analog
DAS	Data Acquisition System
DB	Data Base
DBMS	Data Base Management System
DBS	Direct Broadcast Satellite
DBT	Design Build Team
dc	Direct Current
DCA	Defense Communications Agency
DDT&E	Design, Development, Test and Evaluation
DFT	Design For Testability DMS Data Management System
DOD,DoD	Department of Defense
DOMSAT	Domestic Communication Satellite
DPS	Data Processing System
DR	Discrepancy Report
DSCS	Defense Satellite Communication System
DSN	Deep Space Network DSP Defense Support Program
DTC	Design to Cost
ECLSS	Environmental Control & Life Support System
ECS	Environmental Control System
EECOM	Electrical, Environmental, Communications
EIU	Engine Interface Unit
ELS	Eastern Launch Site
ELV	Expendable Launch Vehicle
EMC	Electro Magnetic Compatibility
EMU	Extravehicular Mobilility Unit; Extended Memory Unit
EPD&C	Electrical Power Distribution and Control
EPS	Electrical Power Subsystem
ES	Expert System
ESS	Energy Storage System
E/T	External Tank
ETR	Eastern Test Range
EVA	Extravehicular Activity
FAA	Federal Aviation Administration
FCE	Flight Crew Equipment
FCM	Fuel Cell Module
FDO	Flight Dynamics Officer
FMS	Flight Management System
FRCS	Forward Reaction Control System
FSS	Flight Systems Simulator
FWC	Filament Wound Case
FY	Fiscal Year
GB	Ground Based
GD	General Dynamics
GEO	Geosynchronous Orbit
GFS	Government Furnished Support
GH2, GH_2	Gaseous Hydrogen
GLOW	Gross Liftoff Weight
GN&C,G&C	Guidance Navigation and Control
GN_2	Gaseous Nitrogen
GO	Ground Operations
GO2,GO_2	Gaseous Oxygen
GPM	Gallons Per Minute
GPS	Global Positioning Satellite
GSE	Ground Support Equipment
GSFC	Goddard Space Flight Center

ACRONYMS and ABBREVIATIONS
(Continued)

GSTDN,STDN	Ground Station Tracking and Data Network
HC	Hydrocarbon
He	Helium
HEO	High Earth Orbit
HIF	Horizontal Integration Facility
HLLV	Heavy Lift Launch Vehicle
HPFTP	High Pressure Fuel Turbo Pump
HTO	Horizontal Take Off
H/W	Hardware
H_2	Hydrogen
HYD	Hydraulic(s)
IC	Integrated Circuit
IDSS	Integrated Design Support System
I/F	Interface
IMIS	Integrated Maintenance Information System
IFA	In-flight Anomaly
ILS	Integrated Logistics System
IMU	Inertial Measurement Unit
INCO	Instrumentation and Communications Officer
INEL	Idaho National Engineering Laboratory
INS,INST	Instrumentation
INT	Integration
IOC	Initial Operational Capability
I/O	Input/Output
IPR	Interim Problem Report
IPV	Individual Pressure Vessel
IR	Infrared
IR&D	Independent Research and Development
IRR	Internal Rate of Return
Isp	Specific Impulse
IU	Interface Unit
IUS	Inertial Upper Stage
JSC	Johnson Space Center
K	Thousand
KEW	Kinetic Energy Weapon
KSC	Kennedy Space Center
KW	Kilowatt
LAN	Local Area Network
LBS	pounds
LCA	Launch Control Amplifier
LCC	Life Cycle Cost
LCCV	Low Cost Cargo Vehicle (MMC)
LCE	Low Cost Expendable
LCEP	Low Cost Expendable Propulsion
LC-Titan	Large Core Titan
LDC	Large Diameter Core
LEM	Lunar Excursion Module
LES	Launch Escape System
LEO	Low Earth Orbit
LH	Left Hand
LH2,LH2	Liquid Hydrogen
$Li-SOCl_2$	Lithium Sulphur Oxygen Chlorine
Li	Lithium
LN_2	Liquid Nitrogen
$LO2,LO_2$	Liquid Oxygen

ACRONYMS and ABBREVIATIONS
(Continued)

LPS	Launch Processing System
LRBs	Liquid Rocket Boosters
LRE	Liquid Rocket Engine
LRU	Line Replaceable Unit
LSC	Linear Shaped Charge
LV	Launch Vehicle
L&L	Launch and Landing
M	Million
MC	Mission Control
MCC	Main Combustion Chamber
MCR	Modification Change Request
MCS	Mission Control System
MCT	Mission Control Teams
MDAC	McDonnell Douglas Astronautics Company
MDM	Multiplex/De-multiplex
ME	Main Engine; Maintenance Expert
MELV	Medium Expendable Launch Vehicle
MEO	Medium Earth Orbit
MFRCV	Manned Fully Reusable Cargo Vehicle(s) (STS II)
MFRGB	Manned Fully Reusable Ground Based-OTV
MFRSB	Manned Fully Reusable Space Based-OTV
MILSTAR	Military Transmission and Relay Satellite
MLP	Mobile Launcher Platform
MMC	Martin Marietta Company
MMMA	Martin Marietta Michoud Aerospace
MMU	Manned Maneuvering Unit
MPM	Manipulator Positioning Mechanism
MPRCV	Manned Partially Reusable Cargo Vehicle
MPS	Main Propulsion System
MPSR	Multipurpose Support Room
MPST	Multipurpose Support Team
MSBLS	Microwave Scanning Beam Landing System
MSFC	Marshall Space Flight Center
MS/NAS	Machine Screw/National Aircraft Standard
MTBF	Mean-Time Between Failure
MTTR	Mean-Time to Repair
NaS	Sodium Sulphur
NAS	National Airspace System
NA-S	National Aircraft Standard
NASA	National Aeronautics and Space Administration
NASA/RECON	Remote Console (NASA information retrieval system)
NCCS	Network Communication and Control Stations
NCS	Network Control Stations
NDE	Non-Destructive Evaluation
NDT	Non-Destructive Test
Ni-Cd	Nickel-Cadmium
NiCad	Nickel Cadmium
NIH	Not Invented Here
$Ni-H_2$	Nickel-Hydrogen
NiTi	Nickel-Titanium
Nitinol	Nickel-Titanium-Naval Ordnance Laboratory
NLG	Nose Landing Gear
NORAD	North American Air Defense
NSI	NASA Standard Initiator
N_2H_4	Hydrazine Monopropellant
N_2O_4	Nitrogen Tetroxide

ACRONYMS and ABBREVIATIONS
(Continued)

OAA	Orbiter Access Arm
OBECO	Outboard Engine Cutoff
O&M	Operations and Maintenance
OMI	Operations and Maintenance Instruction
OMP	Operationsand Maintenance Plan
OMRSD	Operational Maintenance Requirements and Specifications Document
OMS	Orbital Maneuvering System
OMV	Orbital Maneuvering Vehicle
OPC	Operations Planning Center
OPF	Orbiter Processing Facility
OPS	Operations
ORB	Orbiter
ORU	Orbiter Replacement Unit; Orbital Repaired Unit
OTV	Oribital Transfer Vehicle
OV	Orbiter Vehicle
P/A	Propulsion/Avionics Module
PAM	Payload Assist Module; Payload Applications Module
PAREC	P/A Recovery Area
PC	Printed Circuit
PCBS	Printed Circuit Boards
PCP	Power Control Panel
PCR	Payload Changeout Room
PDI	Payload Data Interleaver
PDR	Preliminary Design Review
PFLB	Pressure Fed Liquid Booster
P/FRCV	Partially/Fully Reusable Cargo Vehicle
PGHM	Payload Ground Handling Mechanism
PGOC	Payload Ground Operations Contractor (MDAC)
PIC	Pyro Initiator Controller
PIDB	Preliminary Issues Database
PL, P/L	Payload
PLB	Payload Bay
PLF	Payload Fairing or Payload Facility
POCC	Payload Operations Control Center
POI	Product of Inertia
PR	Problem Report
PRCBD	Program Review Control Board Directive
PRSD	Power Reactant Storage and Distribution
PSA	Payload Support Avionics
PSI	Pounds Per Square Inch
PSP	Processing Support Plan
PV	Present Value
PV&D	Purge, Vent and Drain
QA	Quality Assurance
QC	Quality Control
QD	Quick Disconnect
RADC	Rome Air Development Center
RAMCAD	Reliability and Maintainability through Computer Aided Design
RCC	Reinforced Carbon Carbon
RCS	Reaction Control System
R&D	Research and Development
RECON	Remote Console (NASA information retrieval system)
RF	Radio Frequency
RFCS	Regenerative Fuel Cell System
RFP	Request for Proposal

ACRONYMS and ABBREVIATIONS
(Continued)

RH	Right Hand
RIC	Rockwell International Corporation
RJDA	Reaction Jet Drawer
RMS	Remote Manipulator System
R&PM	Research and Program Management
RPSF	Remote Processing and Storage Facility(s)
RP-1	Rocket propellant-JP-X based
R/R,R&R	Repair/Replace
RSI	Reusable Surface Insulation
RTOMI	Repetitive Task Operations and Maintenance Instruction
RTS	Remote Tracking System
RTV	Room Temperature Vulcanizing
R&T	Research and Technology
RU	Remote Unit
S	Sulphur
SAFT	Semi-Automatic Flight Line Tester
SAT	Satellite
S&A	Safe and Arm
SB	Space Based
SBS	Space Based System
SBSS	Space Based Space Surveillance (System)
S/C	Spacecraft
SCAPE	Self-Contained Atmospheric Protective Ensemble
SDI	Space Defense Initiative
SDIO	Space Defense Initiative Office/Organization
SDV	Shuttle Derived Vehicle
SiC	Silicon Carbine
SIP	Standard Interface Panel; Strain Isolation Pad
SIT	System Integrated Test
SLSOC	Simplified Launch System Operational Criteria
SM	Support Module
SMA	Shape-Memory Alloy
SMCH	Standard Mission Cable Harness
SME	Shape Memory Effect
SOA	State-of-Art
SOC	Satellite Operations Center
SOPC	Shuttle Operations Planning Center
SOW	Statement of Work
SPACECOM	Space Command
SPADOC	Space Defense Operations Center
SPC	Shuttle Processing Contractor (Lockheed)
SPIDPO	Shuttle Payload Integration and Development Program Office (JSC)
SPDMS	Shuttle Processing Data Management System
SPI	Standard Practice Instructions
SRB, SRBs	Solid Rocket Booster(s)
SRM, SRMs	Solid Rocket Motor(s)
SRSS	Shuttle Range Safety System
SS	Space Station
SSME	Space Shuttle Main Engine(s)
SSMEC	Space Shuttle Main Engine Controller
SSSF	SRB Segment Storage Facility
SSTO	Single Stage to Orbit
ST	Space Telescope
STA,STAS	Space Transportation Architecture (Study)
STC	Satellite Test Center
STE	Systems Test and Evaluation or Special Test Equipment
STS	Space Transportation System; Shuttle Transportation System

ACRONYMS and ABBREVIATIONS
(Continued)

STS II	Space Transportation System II
SV	Space Vehicle
S\W,(SW)	Software
T-III	Titan III
TACAN	Tactical Navigation
TARS	Turnaround and Reconfiguration Simulation
TAV	Transatmospheric Vehicle
TBD	To be Determined/Defined
T&C/O	Test and Checkout
TDAS	Tracking and Data Acquisition Satellite
TDRS	Tracking and Data Relay Satellite
TDRSS	Tracking and Data Relay Satellite System
TE	Test Equipment
Tempest	Electromagnetic emission suppression for security purposes
TIS	Technology Identification Sheet
TM	Telemetry
TP	Test Point; Test Plan
T-0	Liftoff Time
TOs	Transfer Orbit Stage
TPS	Thermal Protection System; Test Preparation Test
TRAJ	Trajectory
TS	Transportation System
T/S	Test Setup
TSM	Tail Service Mast
T&CN	Telemetry & Communication Network
TTL	Transistor/Transistor Logic
TVC	Thrust Vector Control
UART	Universal Asynchonous Transistor
UDMH	Unsymmetrical Dimethylhydrazine
UDS	Universal Documentation System
UEXCV	Unmanned Expendable Cargo Vehicle
UFRCV	Unmanned Fully Reusable Cargo Vehicle
UFRGB	Unmanned Fully Reusable Ground Based-OTV
UFRSB	Unmanned Fully Reusable Space Based-OTV
UHF	Ultra High Frequency
ULCE	Unified Life Cycle Engineering
ULV	Unmanned Launch Vehicle
UPRCV	Unmanned Partially Reusable Cargo Vehicle(s)
UPRCV(R)	Unmanned Partially Reusable Cargo Vehicle with Return
UPXCV	Unmanned Partially Expendable Cargo Vehicle
UMB	Umbilical
VAB	Vehicle Assembly Building
VAFB	Vandenberg Air Force Base
VC1	Visual Clean 1 (standard)
VC1A	Visual Clean 1A (sensitive)
VC2	Visual Clean 2 (highly sensitive)
VHF	Very High Frequency
VHMS	Vehicle Health Monitoring System
VHSIC	Very High Speed Integrated Circuit
VIB	Vertical Integration Building
VIF	Vertical Integration Facility
VLSI	Very Large Scale Integration
VPF	Vertical Processing Facility

ACRONYMS and ABBREVIATIONS
(Continued)

WAD	Work Authorization Document
WBS	Work Breakdown Structure
WEM	Water Electrolysis Module
WCCS	Window Cavity Conditioning System
WSMC	Western Space and Missile Center
WCS	Waste Conditioning System
WSB	Water Spray Boiler
WTR	Western Test Range
XTKB	Expanded Technology Knowledge Base

"**The BETTER is the enemy of the GOOD.**"

J.R.Thompson
Director, MSFC

INTRODUCTION

Life Cycle Costs (LCC) of contemporary American launch vehicle systems have been significantly influenced by excessive operations costs. For instance, recent studies have revealed operations costs for the Space Shuttle program are 73% of the LCC. This situation has arisen from the normally accepted practice of designing launch vehicles for maximum performance, i.e., propulsion systems having maximum specific impulse and minimum weight (leading to maximum chamber pressure, maximum turbo-pump performance, maximum thrust-to-weight ratio, use of high-performance hazardous commodities, etc.), with operations and maintainability analyses performed outside the design process "after the fact". This approach unwittingly sacrifices operational issues for ballistic performance, and fails to emphasize criteria such as weight-to-orbit per year per dollar.

As a result, after hardware is shipped to the launch site, the onus is on operations personnel to "make it work". Fortunately, the launch site has been quite successful in making it work, but the cost has been, and is, excessive; unacceptably so for any large-scale future space activities.

This document is a recipe book for simplified ground operations that can result from application of concepts that compromise ballistic performance for "usability" and "reliable launch-on-schedule". It has been prepared for presentation to the Advanced Launch System (ALS), Phase 2, vehicle contractor program management and design elements during "roundtable workshops" sponsored by USAF/SD and NASA/KSC. Those contractors are Boeing Aerospace (Seattle), General Dynamics (San Diego), and Martin-Marietta (Denver).

Principal elements of this book take the form of "Simplified Launch Systems Operational Criteria" (**SLSOCs**). The contents represent culmination of two-and-one-half years work on the Shuttle Ground Operations Efficiencies/ Technologies Study by BAO at Kennedy Space Center. During this study major ground processing time and manpower "tent poles" have been identified, quantified where possible, and documented in earlier reports.

CAUTION: These SLSOCs cannot usually be "picked apart" or effectively analyzed for program-level trade studies as individual items. Data are not available at the granularity necessary to assess each contributor to ground operations LCC. It is the context of the entire SLSOC spectrum that can, as an integrated whole, enable dramatic cost reductions demanded of the next generation launch vehicles. For instance, elimination of ground power, multiple facility, repetitive, integrated system-level testing, et al, cannot usually be costed as independent entities. Many of the systems addressed are too pervasive throughout the operation to be accurately examined for cost and time impact.

Goal of the study in general, and the workshops in particular, is to expose creator/designers of the next generation heavy-lift launch vehicles to improved visibility of ground processing dependence on basic vehicle configuration. The prime message here is that vehicle systems quantity, complexity, and use of hazardous systems/materials have a profound (frequently unsuspected) impact on ground processing time, facilities, GSE, and manpower.

Quantified Space Shuttle KSC ground processing data are used as baseline reference points for future design trade studies. The mode for presenting these data is the SLSOC. Tent pole-related management and hardware systems, addressed in these criteria, have been divided into six major criteria categories. Those

INTRODUCTION (Cont.)

categories represent the prime "chapters" of this document and are:

- o Management and System Engineering
- o Avionics and Software
- o Power
- o Structures and Materials
- o Propulsion
- o Facilities and Support Equipment

The SLSOC elements presented herein all have impact on ground processing operations and are listed in Figure 1. The criteria are presented and developed in the body of this document with the following general format:

SLSOC FORMAT

o <u>No:</u> (number) and <u>Title:</u>

o <u>Operations Requirement:</u> A brief description of the desired element.

o <u>Rationale:</u> Rationale for the desired change or variation from contemporary systems with quantified evidential data, where possible, (as compared with shuttle type operations) showing potential program enhancement in manpower reduction, processing time reduction, or material cost reduction.

o <u>Sample Concept:</u> A sample of the desired elemental change fulfilling the envisioned simplification.

o <u>Technology Requirement:</u> Interpretation of existing or new technology necessary to enable the concept.

o <u>Technology References:</u> The bulk of this document consists of more than 450 technology reference titles, sources, and abstracts. The references were acquired by computerized research of either NASA/RECON or DIALOG. RECON data were extracted using the XTKB (Extended Technology Knowledge Base), a Boeing automation tool that sorts and lists "secondary keys" by primary topic.

DIALOG references were extracted from various data bases, e.g., NTIS, INSPEC, etc., via Dialog Information Services, Inc., Palo Alto, California.

It is recognized that designers already have comprehensive reference files for their specialties; nevertheless, they may find some additional useful abstracts. For those interested in the technology, these references present an overview of available documentation.

o <u>Conclusions:</u> A few criteria include quantified Shuttle comparison data and potential developmental benefits, and are terminated with the appropriate related conclusions.

The six major divisions (or chapters, as noted earlier) are informally segregated in content to individual sections, each prefaced by a SLSOC, followed by a collection of directly related technology reference abstracts . A sample SLSOC is reproduced below, incidentally revealing some authentic "real world" cost data, providing incentive for the drastic rethinking of launch vehicle design and ground processing promoted by this study.

SIMPLIFIED LAUNCH SYSTEM OPERATIONAL CRITERIA (SLSOC)

MANAGEMENT & SYSTEM ENGINEERING

- M 1) ● PROCUREMENT
- M 2) ● DESIGN / BUILD TEAMS
- M 3) ● DEMING STYLE MANAGEMENT
- M 4) ● LIFE CYCLE COSTS
- M 5) ● DESIGN TO COST
- M 6) ● UNIFIED LIFE CYCLE ENGINEERING
- M 7) ● RISK MANAGEMENT
- M 8) ● RELIABILITY / OPERABILITY
- M 9) ● MAINTAINABILITY / SUPPORTABILITY
- M 10) ● LOGISTICS SUPPORT
- M 11) ● OPERATIONAL TEST REQUIREMENTS
- M 12) ● QUALITY ASSURANCE
- M 13) ● SAFETY
- M 14) ● SECURITY
- M 15) ● CONNECTIVITY ARCHITECTURE

ELIMINATE

- M 1) O MULTIPLE PRIME CONTRACTORS ON SAME PROGRAM
- M 8) O TIGER TEAMS FOR STATUS (SEE L 1) (Requires 100% Computer Connectivity)
- M 1) O SEPARATE DESIGN CONTRACTORS / VOLUMINOUS INTERFACE CONTROL
- M 12) O LARGE QUALITY INSPECTION TEAMS
- M 10) O CANNIBALIZATION
- M 4) O COST OVERRUNS & UNLIMITED LCC
- M 7) O EXORBITANT COST TO ATTEMPT ZERO RISK REQUIREMENTS

AVIONICS & SOFTWARE

- ● AUTONOMOUS VEHICLE
  - A 1) ● BIT / BITE (ON - BOARD CHECKOUT)
  - A 2) ● FAULT TOLERANT AVIONICS SUITE
  - A 1) ● VEHICLE HEALTH & STATUS MONITORING SYSTEM
  - A 4) ● MINIMAL LAUNCH CONTROL INTERFACE
  - A 1) ● RETURNED VEHICLE SELF - TEST FOR REFLIGHT
  - A 3) ● AUTONOMOUS G N&C
  - A 4) ● OPTICAL / IR / RF LINK ONLY TO GSE
- ● SOFTWARE
  - A 5) ● COMMON "CORE" SOFTWARE FOR C/O, LAUNCH, FLIGHT
  - A 5) ● OPERATIONS DATA OVERLAYS (C / O, LAUNCH, MISSION)

ELIMINATE

- A 6) O RELATED GSE
- A 4) O HARDWIRE CONNECTS TO GSE
- E 1) O GROUND POWER REQUIREMENTS

POWER

- E) ● LOW MAINTENANCE ENERGY STORAGE
- E) ● PROPELLANT GRADE FUEL CELLS
- E) ● STATE - OF - ART ENERGY SOURCES
- E) ● SYSTEM SIZED TO PROVIDE ON - BD PWR FOR GROUND OPERATIONS

ELIMINATE

- A 6) O RELATED GSE
- E) O GROUND POWER REQMTS

STRUCTURES & MATERIALS

- ● IMPROVED STRUCTURE
  - S 1) ● MINIMIZE LEAK PATHS
  - S 2) ● STRUCTURAL INTEGRITY VERIFICATION
  - S 3) ● INTEGRAL TPS
- S 4) ● ORDNANCE
  - S 4.1) ● WEAPON DESTRUCT
  - S 4.2) ● LASER IGNITION
  - S 4.3) ● ACCELERATION / CLEVIS SEPARATION
  - S 4) ● NITINOL / E - M DEVICES

ELIMINATE

- S 3) O SEPARABLE TPS
- S 4) O ALL ORDNANCE
- S 4) O PROCESSING SAFETY RESTRICTIONS

PROPULSION

- ● INTEGRATED PROPULSION SYSTEM
  - P1) ● SIMPLIFIED ROBUST PROPULSION SYSTEM
  - P1.1) ● FULLY THROTTLEABLE ENGINES (MULTI-PHASE)
  - P1.2) ● SOFT ENGINE START
  - P1.3) ● TVC BY DELTA THRUST AND/ OR RCS / OR AERO
  - P1.4) ● ONE OXIDIZER / ONE FUEL

ELIMINATE

- P 3) O SEPARATE OMS AND RCS
- P 3) O HIGH MAINTENANCE TURBOPUMPS
- P 4) O HYDRAULICS
- P 5) O HYPERGOLS
- P 6) O GN_2 / He ON-BOARD PURGES
- P 7) O GN_2 / He PRESSURE SYSTEM
- P 8) O GIMBALLED ENGINES
- P 9) O EXTENSIVE RECOVERY & REFURBISHMENT

FACILITIES & SUPPORT EQUIPMENT

- L 1) ● 100% COMPUTER CONNECTIVITY
- ● AUTOMATION
  - L 2) ● ELECTRONIC OMI's
  - L 3) ● TEXT AND GRAPHICAL DATA ACQUISITION
  - L 4) ● TEST REQUIREMENT VERIFICATION
- ● STAGE ASSEMBLY
  - L 5) ● INITIAL NEAR LAUNCH CENTER
  - L 5) ● FINAL AT LAUNCH CENTER
- L 6) ● HORIZONTAL PROCESSING
  - L 7) ● HORIZONTAL TRANSPORT
- ● PAYLOADS
  - L 10) ● ONE AUTONOMOUS CONTAINER
- ● PAD
  - L 8) ● BARREN PAD
  - L 9) ● ERECT / MATE STAGES AT PAD
  - L 8.1) ● DEEP WATER EXHAUST BUFFER
  - L 8) ● LIGHTNING / LIGHTING TOWER
  - L 8.2) ● FLY-AWAY CONNECTS ONLY
  - L 8) ● PROPELLANT FARM
  - L 6) ● PAVED TOW - WAY
- ● MOBILE EQUIPMENT
  - L 6 ● STANDARD AIRCRAFT TUG
  - L 6 ● STRAP-ON WHEELED DOLLIES
  - L 6 ● MOBILE CRANE
- ● BUILDINGS
  - L 6 ● HORIZONTAL PROCESSING FACILITY

ELIMINATE

- O AUTOMATION
  - L 1) O ISOLATED DATABASES
  - L 2) O PAPERWORK RELATED TO TEST
  - L 4) O REQUIREMENTS VERIFICATION
  - L 3) O PRINTED TRANSFER OF TEXT / DATA
- L 10) O PAYLOAD / VEHICLE INTEGRATION VERIFICATION TESTING
- L 9) O LIFTING VEHICLES CLEAR OF GROUND
- O PAD EQUIPMENT
  - L 4) O HARDWIRE CONNECTS
  - L 8.4) O ACCESS STRUCTURES
  - L 8.3) O SWINGARMS
  - L 8) O RETRACTING UMBILICALS
  - L 8.5) O T-O HOLD-DOWN
  - L 8.6) O DELUGE WATER
  - L 8.6) O SOUND SUPPRESSION WATER
  - L 8.1) O FLAME TRENCH / DEFLECTOR
  - L 8.7) O ECS
  - P 6) O He / GN_2 STORAGE
  - E) O GROUND POWER
  - L 7) O CRAWLER WAY
- O MOBILE EQUIPMENT
  - L 7) O CRAWLER / TRANSPORTER
  - L 7) O MOBILE LAUNCH PLATFORM
- O BUILDINGS
  - L 6) O VAB
  - L 6) O VPF
  - L 6) O RPSF

Figure 1

EXAMPLE: SIMPLIFIED LAUNCH SYSTEM OPERATIONAL CRITERIA

No: M4 **Title:** Life Cycle Costs

Operations Requirement:

Operations efficiency must be considered during concept development and design.

Rationale:

Operations requirements have been disregarded in the past because they are brought up too late in the design cycle to be implemented in a cost-effective manner.

FOR EXAMPLE (FY-85 STS OPERATIONS COSTS FOR 8 FLIGHTS)

SRB	$464.2M	FLIGHT OPS	$345.3M
ET	415.8M	ORBITER HDWRE	162.6M
LAUNCH OPS	347.5M	CREW EQUIP	36.3M
PROPELLANTS	30.3M	SSME	51.6M
GSE	24.1M	CONTRACT ADMIN	17.1M

SUBTOTAL $1894.8M

PLUS NETWORK SUPPORT	$ 20.4M	
R&PM	274.2M	
FY-85 TOTAL COST	$2189.4M	($273.7M ea.for 8 flights)

Minimizing upfront costs multiplies Life Cycle Cost.

Sample Concept:

- Do not sacrifice operational efficiency for vehicle performance. Build a truck - not a Ferrari.
- Prepare thorough and realistic life cycle cost analysis for Congress.
- Emphasize Life Cycle Cost - not start-up costs.
- Implement tools listed below.

Technology Requirement:

No new technology required, only further development and implementation of the proper concepts and tools:

DEMING MANAGEMENT AND QUALITY TECHNIQUE
ULCE (Unified Life Cycle Engineering)
DESIGN/BUILD TEAMS
MAINTAINABILITY
SUPPORTABILITY
DESIGN-TO-COST
MANDATORY MTBF/MTTR

Technology References:

NASA RECON: (Abstracts attached) 86X75319, 86N28011, 86A42678, 86A42618, 86A21872, 86A10929, 85A45150, 85N30966, 85A42678, 84X78919, 84N31062, 84N26962, 84N24495, 84N23330, 84A15212, 83A43748, 84A30608, 83A49578, 83A48334, 82A14787, 81N11907, 81A30295

STS-31 MANPOWER DATA - A DESIGNERS REFERENCE

The following tabulation of STS-31 ground processing technician actual manhours is extracted from the Pan Am "Shuttle II Data Base" to assist system designers in understanding relative magnitude of systems impact on a contemporary American launch site. **BEWARE:** Listed manhours do not tell the full story! Several systems ,e.g., hydraulics, hypergols, and pyrotechnics, infiltrate overall productivity in a subtle, pervasive, frequently unsuspected manner. The SLSOCs in this document attempt to reveal the "invisible tentpoles".

The data are for orbiter Atlantis, launched November 26, 1985. The workforce and skill-mix ratios represent normal response to be expected of any major American aerospace contractor to the complex and highly comprehensive requirements; e.g. system OMRSDs, safety, quality, etc., etc.

TASK	ORBITER TECH, MHs		ET/SRB TECH, MHs
LANDING - DFRC	5,428		-
ORBITER PROCESSING -OPF	39,037		-
o Unscheduled maint.		2,488	-
o Scheduled maint.		(34,311)	-
. 00 Cargo reconfig.		3,336	-
. 01 Qual. engrg.		1,020	-
. 03 Integration		186	-
. 05 Purge, vent & drain		656	-
. 07 Mechanisms		1,611	-
. 08 Struct/handling		2,932	-
. 09 Thermal prot. sys.		10,636	-
. 41 Main prop./SSME		7,012	-
. 43 Reaction control		1,288	-
. 45 Fuel cell/PRSD		248	-
. 46 Aux. power unit		416	-
. 50 Launch accessories		90	-
. 54 Experiments/optics		90	-
. 55 Pyro/range safety		292	-
. 58 Hydraulics		1,045	-
. 60 Eviron. cont./life		1,724	-
. 66 Flt. crew sys.		208	-
. 70 Guidance & nav.		780	-
. 73 Digital sys.		226	-
. 74 Comm. & tracking		135	-
. 75 Instrumentation		76	-
. 76 Elec. power dist.		224	-
. 93 On-board software		80	-
o Orbiter Shops		1,974	-
o Modifications		264	-
VAB INTEGRATION	2,905		2,606
PAD OPERATIONS	24,823		14,365[1]
TOTAL TECH MHs (No overtime)[2]	72,193		16,971

(1) Includes all Morton-Thiokol ET/SRB preps prior to orbiter/booster integ.
(2) Tech O/T hrs. approx. 50% during critical opers.; net SPC effect approx. 20%

STS-31 MANPOWER DATA (Cont.)

The above manhours are for technicians only. To interpret functional support manpower, i.e., total manpower, the following ratios existed and must be applied:

SKILLS	MH RATIO (Specialty/Tech)
. Technicians (vehicle)	1.00 (Above MH data base)
. Engineering (vehicle)	.89
. Safety	.08
. Quality	.38
. Planning (PP&C)	.22
. Support (test cond/mgmt, computer & S/W, facs, comm)	1.85
. Logistics	.53
. Overhead (all mgmt, admin, secur, business, subcon)	.42

TOTAL SPC HEADCOUNT CHARGED TO STS-31 - 3,460 (2 vehicles in process)

TOTAL SPC MANHOURS CHARGED TO STS-31 - 391,631

STS-31 ORBITER DWELL TIMES

- Landing Ops. (VAFB) - 4 days
- Orbiter Proc. Fac. - 27 days
- Vehicle Assy. Bldg. - 4 days
- Launch Pad - 15 days

Total Cycle - 50 days

CRITERIA SOURCES AND RESPONSIBILITY

"Criteria" presented in this document are the result of comments and input from numerous KSC/CCAFS-experienced contractor and Civil Service personnel. The launch operations experience base goes back as far as Bomarc and encompasses applicable "hands-on" time with programs including Saturn S-1B, Saturn-Apollo, Spacelab, Apollo-Soyuz, and, of course, Space Shuttle. The concepts presented in these criteria are the **sole responsibility** of the principal investigators, and not necessarily those of NASA/KSC Engineering Development.

At first approach some of the criteria may seem less than credible. Note however, that enabling technology limitations are included as part of the writeups, e.g., much dependence upon a presently unavailable "gee-whiz" high-density electrical power supply. A large majority of the innovations do not require significant high-tech development, only acceptance of radical simplification of vehicle, GSE, ground operations methodology, and elimination of productivity-robbing hazardous materials. Repeated exposure to these radical (and sometimes austere) concepts is foreseen as a necessary precursor to gradual understanding and acceptance.

It is a simple extrapolation from cost data in the above SLSOC example to realize that full, real cost for placing a pound of Shuttle payload in low earth orbit during the 8 flights of FY 1985 was $5500. This is a desperate incentive for America to totally overhaul (simplify) its flight hardware, ground support operations, and related institutional culture. The most fertile area for that overhaul is thorough integration of simplified launch system operational criteria with vehicle preliminary concept design. Prime goal of these workshops is to stimulate the radical, even unorthodox, thought processes necessary to achieve the 10-fold reduction in orbital payload delivery cost sought by ALS.

APPENDIX

Appendix A, "STS-26R Fluids Consumption and Cost Data" presents commodities quantities and cost data for "return-to-flight" launch of orbiter Discovery September 29, 1988. It is intended to provide designers a baseline of actual LOX, LH2, GN2, GHE, hypergol, and other fluid expenditures.

DATA SOURCES

This document contains a variety of KSC Shuttle processing headcount, ground processing timeline, and material quantity/cost data obtained primarily from the following sources:

- SGOE/T Study, Phase 2 Report, Volume 6, "Circa 2000 System", dated May 5, 1988.
    - Appendix A "Headcount Estimation" - SPC work scope and headcount by WBS to the fourth digit.
    - Appendix B "Ground Processing Timelines" - Actual turnaround timeline data for 51-L by major work categories and related prime work authorization documents (WADs).
- SGOE/T Study, Phase 2 Report Addendum, Volume 6, "51-L Work Volume Indicators", dated September 30, 1988.
- "SPC Bottoms-Up Manpower Review", NASA/KSC, dated June 1987.
- "Shuttle II Data Base Development", Prepared for Teledyne Brown Engineering (Huntsville) by Pan Am World Services, Inc. (Cocoa Beach), - STS-31 processing headcount and WAD data by vehicle system, including actual technician manhours with skill mix ratios for all major functional support areas, dated July 24, 1987.
- Congressional Budget Office - FY 85 STS Recurring Costs.

SUMMARY

What can this document and related SGOE/T references do for program managers and designers responsible for the next generation of launch vehicles? If the concepts and "tentpole influence factors" presented here are applied with a vengeance during initial concept and preliminary design, the next family of ground processing facilities, launch pads, GSE, and launch vehicles will truly be a **family**, will have little semblance to contemporary counterparts, and will hold great promise of reducing repetitive lifecycle costs to a small fraction (yes, 10% !) of today's unacceptable values.

The Management and System Engineering section presents a comprehensive variety of management and system engineering criteria necessary at the foundation of a SLSOC program to conceive and implement a majority of these "radical" hardware and operational concepts. There are 3 management (M1-M3) and 12 system engineering (M4-M15) items identified.

- Criterion M4 addresses the exorbitant operations cost that are being experienced with the current configuration of the STS. Actuals from FY 1985 document a total operations expenditure per flight of $273.7M (or $5474/LB). Specific recommendations are made and technologies are identified that may be of use in avoiding these high costs in future systems. These concepts are support with additional detail in M5-M15.

These criteria are the first steps in reshaping, and totally rethinking basic design concepts essential to major cost reductions. Many "sacred cows", managerial, hardware, and operational, must be sacrificed. Fifteen relative SLSOCs and 51 technology reference abstracts are presented.

The Avionics and Software section presents experienced insight into related elements found to have highly significant impact on Shuttle ground processing. All of the items discussed here are related to ground operations vehicle checkout and launch sequencing.

The original ,160 hour turn-around, allocation of 5 hours for 'Unscheduled Maintenance and System Reverification' and 24 hours for 'Orbiter Scheduled Maintenance' was in reality 753 hours and 1133 hours respectively for flight 51-L (SGOE/T phase 1 final report volume 2 pages 14 & 16). The reasons for a large portion of this overrun are identified in this section.

The criteria represent existing "real-world" electronics capability. Seven relative SLSOCs and 112 technology reference abstracts are presented.

The Power section contains a primary keystone of criteria to achieving a truly simplified launch system. The vehicle must be as autonomous in its electrical power requirements as technically possible. Vehicle and/or individual systems "power-up" for T&C/O must be eliminated as a repetitious "big deal" event. Highly complex military and civil aircraft are powered-up daily without need of complex facilities, "control tower" interface, or related scheduling and control overview. Admittedly, these concepts are highly dependent on a non-existent "gee-whiz" power source and/or completely innovative operational design considerations. The need is real and pressing. One integrated SLSOC and 59 technology reference abstracts are presented.

The Structures and Materials section beats heavily on Shuttle-style, delicate, complex TPS, and also goes to combat with productivity-interfering ordnance. All ordnance is perceived by responsible safety elements as a serious potential hazard and is accommodated with stringent, complex procedures and document-trail safeguards. Design alternatives to pyrotechnics include use of shape-memory metals (Nitinol), range destruct via external ground or aircraft-delivered weapons, and innovative stage separation automatically (and simply) initiated at engine shutdown and controlled aerodynamically during separation. These

concepts are seriously, even if radically, proposed as samples of thought essential to momentous cost reduction.

Four pertinent SLSOCs and 87 technology reference abstracts are presented. The following include quantified study data:

- o Criterion S3 addresses **TPS** and includes a quantified exercise which concludes the possibility of reducing the TPS-related Shuttle-equivalent headcount by **162 people**; a highly significant, but unsurprising, conclusion.

- o Criterion S4 addresses **Ordnance**, and also includes a quantified exercise, concluding that total elimination of pyrotechnic devices may reduce Shuttle-equivalent headcount by **60 persons**, and might decrease the ground processing timeline as much as 1 day per flow. Examination of as-run Shuttle schedules reveals that most ordnance work is performed on late night shifts and in parallel with other vehicle work. The identified headcount is therefore somewhat surprising.

The Propulsion section provides a variety of ideas for simplification, and ground processing timeline improvements, e.g., elimination of TVC by engine gimballing and its pervasive infiltration of ground processing. More pointedly, quantified exercises for hydraulics, hypergols, and gaseous purge/pressurization systems are presented.

Nine SLSOCs are presented and include rationale and samples for future program simplification. 77 technology reference abstracts are also presented. The following SLSOCs include quantified study data:

- o Criterion P4 addresses flight and supporting GSE **hydraulics.** The included quantified exercise goes to some descriptive length to conclude that hydraulics systems create a pervasive, surprisingly large, "invisible tent pole". A decrease in Shuttle-equivalent headcount of **37 people** is shown and defined. Compensating headcount is included.

- o Criterion P5 addresses **hypergol** systems and related ground support. An extensive presentation of operations, GSE, and headcount is presented to substantiate indictment of hypergols. A potential Shuttle-equivalent headcount reduction of **106 people** is identified. Compensating headcount is included.

- o Criteria P6 and P7 briefly discuss gaseous **purge and pressurization** systems. Data to quantify manpower, hardware and processing timeline impact are not readily available. Quantified data for a typical, current launch are shown to produce a nitrogen and helium commodities cost of nearly $.9M for flight hardware support alone.

The Facilities and Support Equipment section presents an extensive dissertation on ground processing methods, facilities and GSE. Horizontal processing and transport of an all-liquid propellant vehicle is proposed, wherein all stages are free of large explosive masses, and are never lifted free of the ground; all in the interest of increased safety, minimized area-clear exercises, and simpler (cheaper) facilities and GSE.

Nine relative SLSOCs and 65 technology references are presented. The following criteria include quantified work scope and headcount data:

- o Criteria L6, L7, and L9 address **horizontal processing, horizontal transport, and stage erection/mating** at the launch pad. They are directly related, interdependent, and analyzed as a single entity.

  Prime feature of this scenario is the elimination of labor-intensive

crawler transporters and mobile launchers with the substitution of "dumb" transporter dollies (either rubber-tired or rail mounted) with stage erection performed virtually free by a robust, innovative mobile crane concept. The conclusion forecasts a potential Shuttle-equivalent headcount reduction of **104 people**, yet includes headcount allowance for the new, radical alternative.

- Criterion L8 addresses the concept of a **"barren pad"** which possesses very few of the "normal" towers, gantries, swing arms, flame deflectors, water deluge/sound suppression, pneumatics, ECS and pad pressurization systems. The barren pad has only an elevated concrete apron, propellant farms, light/lightning arrest towers, stage-mounting/support butts, and deep-water exhaust-flame quench pond. The only vehicle-to-ground hard connects envisioned would be electrical grounding, and lift-off type propellant QDs. Vehicle electrical autonomy (as noted elsewhere herein) would have the additional benefit of eliminating need for hard connection at the pad. Vented fuel gasses might be burned at the vehicle to eliminate the need for the usual extensive "vent-and-burn" farm system; admittedly requiring development of new concepts and systems. Or, alternatively, why not devise a simple cryo heat exchanger to condense would-be vent gasses in the tank? The imagination should not be limited to conventional solutions!

  Conclusion of the L8 work scope and headcount analysis predicts a potential Shuttle-equivalent headcount reduction of **224 people!** Headcount compensation for alternate replacement systems is included.

These simple, limited-scope exercises indicate a realistic (even conservative) potential reduction in Shuttle-equivalent headcount of **693 people** by application of these few SLSOCs bearing quantified data. In summary these are:

. Provide robust TPS	-162
. Eliminate pyrotechnics	- 60
. Eliminate hydraulics	- 37
. Eliminate hypergols	-106
. Eliminate CTs & MLPs	-104
. Provide barren pad	-224

This is only one of several essential giant steps in the right direction. Those SLSOCs relating to management, document automation, PP&C scheduling and reporting automation, and the entire family of on-line, interconnected computer-controlled enhancements can (and must) enable equally dramatic improvements in time and cost reduction.

The launch systems LCC iceberg has been attacked by the heat of SLSOC examination. The main body of the iceberg (multiple complex facilities, GSE, flight hardware, O&M Requirements, and many many people) is a large structure necessarily built to house a very complex, interrelated, intensely managed launch system. It might be compared to a grand seven-story mansion, whereas SLSOC suggests a four-story condominium is adequate and cost-effective.

"New-think" simplification and reduction of future flight hardware systems quantities and complexity, integrated with the simplest overall ground processing configuration, are the bedrock foundation of reduced LCC.

In conclusion, although some of the attached SLSOCs will initially be considered overly radical, each is submitted as a serious example of innovative design "rethink" essential for the large , exceedingly difficult cost reduction envisioned by ALS (and mandatory for large-scale emergence of America in space). None of the concepts should be dismissed or ignored, as each, like a lone candle in the dark, can additively create the light necessary for a bright, affordable American space future.

No: M1 **Title:** Procurement

Operations Requirement:

Government procurement must utilize a contracting mode that establishes prime contractors with sufficient system integration authority to define system (hardware and software) configuration requirements. This will enable cost-effective management for the total system architecture (including hardware acceptance and sub-contractor control).

Rationale:

Contracts that specify GFE, such as engines, and dictate detailed specifications rather than end product performance severely limit a prime contractor's ability to achieve the optimum design or manage the job in a cost effective manner. Most detail hardware specifications limit the contractor's capability to be innovative and cost effective.

Sample Concept:

Program level specifications should be developed only for the top level of end product performance and include profit incentives.

Production contracts for systems / components should be placed under control of the prime contractor.

For Example: The lunar orbiter program was a highly successful performance incentive program that operated under this concept.

Technology References:

SGOE/T Study Report, Volume 3, Part 2, 4 May 88.

PAGE 14 INTENTIONALLY BLANK

No: M2 **Title**: Design/Build Teams

Operations Requirement:

Beginning with the conceptual definition through the design phase, integrate the experience and knowledge of specialists in all areas, including manufacturing, procurement, ground operations, etc.

Rationale:

As a result of compartmentalized organization responsibilities, past vehicle designs have not fully utilized and integrated the knowledge and experience of specialists in all functional organizations.

The past sequence of hardware development, whereby the hardware designer completes his design (without input from manufacturing, purchasing, operations, etc.) and "throws it over the fence", for the other organizations to do the best they can in producing and operating the hardware in a cost-effective way, has led to life cycle cost an order-of-magnitude higher than necessary.

Sample Concept:

Management must adopt design/build team concepts. This will provide an adequate flow of experience and coordination from operational elements to engineering design during the definition and development stage.

Individual program requirements should determine its organizational structure -- not vice-versa.

Technology Requirement:

Advanced teamwork.

Technology References:

SGOE/T Study Phase 2 Final Report, Volume 3, Part 2, dated 5/4/88.

SGOE/T Study Phase 1 Final Report, Volume 1, pp.14-16, dated 5/4/87.

No: M3 **Title:** Deming Style Management

Operations Requirement:

Traditional compartmented management style must be replaced with Deming-type, team-style management with integrated quality.

Rationale:

In maturing over the past twenty-five years, aerospace management, both in and out of government, have succumbed to bureaucratic disease whereby the first consideration of any management or technical problem is how it will affect the "status quo". If the effect is negative in any way, the answers are often skewed preventing top management from making cost effective decisions. Top management also suffers from biased decisions made to accommodate their "status quo".

Sample Concept:

Computerized databases can eliminate need for many middle managers who now only gather and provide information for top management decisions. This will allow top managers who know how to effectively use computer tools to obtain data that is unfiltered and unbiased by middle management protecting their turf.

Management culture must change to a more participative management style (a la Deming) without wasteful department barriers. This must take place both in NASA and contractor ranks.

With a high percentage of managers in NASA and contractors approaching retirement, there is an unusual opportunity to accomplish the change. Care must be taken not to replace these retiring managers with their look-alike proteges or nothing will be gained. Selection of new managers should be based on their ability to make imaginative use of the latest management technology and who are not ingrained with parochial viewpoints.

The individual program objectives should determine the organization requirement -- not vice-versa.

Technology Requirement:

A total culture change in managerial techniques. Brain restructuring.

Technology References:

"Managing Quality" Handbook, Boeing Aerospace Co., September '85

"The Deming Route to Quality and Productivity", W.W. Scherkenbach 1986.

SGOE/T Study Report, "SOCH Appendices", Draft dated 9/8/87.

No.: M4 **Title:** Life Cycle Costs (LCC)

Operations Requirement:

Operations efficiency must be considered during concept development and design.

Rationale:

Operations requirements have been disregarded in the past because they are brought up too late in the design cycle to be implemented in a cost-effective manner.

FOR EXAMPLE (FY-85 STS OPERATIONS COSTS FOR 8 FLIGHTS):

SRB	$464.2M	FLIGHT OPS	$345.3M
ET	415.8M	ORBITER HDWRE	162.6M
LAUNCH OPS	347.5M	CREW EQUIP	36.3M
PROPELLANTS	30.3M	SSME	51.6M
GSE	24.1M	CONTRACT ADMIN.	17.1M

SUBTOTAL $1894.8M

PLUS NETWORK SUPPORT	$ 20.4M	
R & PM	274.2M	
FY-85 TOTAL COST	$2189.4M	($273.7M ea. for 8 flights)

Minimizing upfront program costs multiplies Life Cycle Cost.

Sample Concept:

- Do not sacrifice operational efficiency for vehicle performance. Build a truck - not a Ferrari.
- Prepare thorough and realistic life cycle cost analysis for Congress. Congress.
- Emphasize Life Cycle Cost - not start-up costs.
- Implement tools listed below.

Technology Requirement:

No new technology required, only further development and implementation of the proper concepts and tools:

DEMING MANAGEMENT AND QUALITY TECHNIQUE
ULCE (Unified Life Cycle Engineering)
DESIGN/BUILD TEAMS
MAINTAINABILITY
SUPPORTABILITY
DESIGN-TO-COST
MANDATORY MTBF/MTTR

Technology References:

NASA/RECON: (Abstracts attached) 86X75319, 86N28011, 86A42678, 86A42618, 86A21872, 86A10929, 85A45150, 85N30966, 85A42678, 84X78919 84N31062, 84N26962, 84N24495, 84N23330, 84A15212, 84A43748 84A30608, 83A49578, 83A48334, 82A14787, 81N11907, 81A30295

86X75319 CATEGORY 83 RPT#: AD-B098546L STC-TM-784 86/01/00 226 PAGES UNCLASSIFIED DOCUMENT NASA PERS. ONLY

UTTL: An interactive life cycle cost model

AUTH: A/CINAR, U.

CORP: Shape Technical Center, The Hague (Netherlands). MFC: 00

CIO: NETHERLANDS

MAJS: / *ACQUISITION/ *COMMAND AND CONTROL/ *COST ANALYSIS/ *COST ESTIMATES/ *LIFE CYCLE COSTS

MINS: / MAN MACHINE SYSTEMS/ MATHEMATICAL MODELS/ NORTH ATLANTIC TREATY ORGANIZATION (NATO)

....

86N28011# ISSUE 18 PAGE 2976 CATEGORY 81 RPT#: AD-A165520 85/12/00 148 PAGES UNCLASSIFIED DOCUMENT

UTTL: Controlling life-cycle cost: A management perspective

TLSP: M.S. Thesis

AUTH: A/PORTER, D. L.

CORP: Naval Postgraduate School, Monterey, Calif. AVAIL.NTIS

SAP: HC A07/MF A01

CIO: UNITED STATES

MAJS: / *COST ESTIMATES/ *ECONOMICS/ *LIFE CYCLE COSTS/ *LOGISTICS/ *PERSONNEL/ * PROCUREMENT MANAGEMENT

MINS: / ARMED FORCES (UNITED STATES)/ GOVERNMENT PROCUREMENT/ NAVY/ PROCUREMENT POLICY

ABA: GRA

ABS: The objective of this thesis is to examine the obstacles which are preventing the Navy from realizing the full economic advantage of a total cost management program for aviation support equipment. The research has shown that Navy program managers are not fully commited to managing life-cycle cost nor is it considered early enough in the procurement process to influence design. To improve the life-cycle cost management effort, existing policies and provisions included in DoD Directives should be applied to aviation support equipment. More emphasis should be placed on the RFP as a means of communicating the Navy's concerns about controlling cost and adequate information should be provided to the contractor to be used in developing realistic cost estimates. Finally, life-cycle cost should be elevated to the level of unit-production cost, schedule and performance and made a mandatory source selection criterion.

....

86A42678# ISSUE 20 PAGE 2938 CATEGORY 20 RPT#: AIAA PAPER 86-1509 86/06/00 10 PAGES UNCLASSIFIED DOCUMENT COPYRIGHT

UTTL: Design of multikilowatt arcjets with high voltage, fixed length, swirl controlled arc discharges

AUTH: A/CANN, G. L.; B/FUGMIRE, T. K. PAA: B/(Technion, Inc., Irvine, CA)

CIO: UNITED STATES AIAA, ASME, SAE, and ASEE, Joint Propulsion Conference, 22nd, Huntsville, AL, June 16-18, 1986. 10 p.

MAJS: / *ARC DISCHARGES/ *ARC JET ENGINES/ *ENGINE DESIGN/ *NOZZLE FLOW/ *PLASMA JETS / *PLASMA PROPULSION

MINS: / ANODES/ CATHODES/ GAS FLOW/ MAGNETIC FIELDS/ PRESSURE VESSELS/ RADIATION SHIELDING

ABA: G.R.

ABS: Current arc heater technology, particularly in applications related to propulsive plasmajets or arcjets, represents a complex field. Aspects of early arcjet development during the period between the late 1950s and

mid-1960s are discussed along with arc heater technology, and the design parameters and operating objectives of a flight useful arcjet. The application of arc heater technology to the design of arcjets is considered, taking into account the 1 KW Arcjet Program, and the 30 KW Arcjet - Proof of Concept Program. It is felt that many of the goals of the considered programs have been met. There remain, however, a number of questions which must be resolved prior to making an application commitment. Thus, a full characterization of operation with propellant injection and flow rates into the swirl and mixing chambers is required, and imprved thermal coupling of the excess anode heat to the expansion nozzle radiator is needed.

....

86A42618# ISSUE 20 PAGE 3010 CATEGORY 83 RPT#: AIAA PAPER 86-1405 86/06/00 12 PAGES UNCLASSIFIED DOCUMENT COPYRIGHT

UTTL: Life Cycle Cost methodology for space station propulsion system

AUTH: A/MEISL, C. J.

PAA: A/(Rockwell International Corp., Rocketdyne Div., Canoga Park, CA)

CIO: UNITED STATES; AIAA, ASME, SAE, and ASEE, Joint Propulsion Conference, 22nd, Huntsville, AL, June 16-18, 1986. 12 p.

MAJS: / *COST REDUCTION/ *DESIGN TO COST/ *LIFE CYCLE COSTS/ *PROPULSION SYSTEM CONFIGURATIONS/ *SPACE STATION PROPULSION

MINS: / COST ESTIMATES/ HYDRAZINES/ HYDROGEN OXYGEN ENGINES/ METHODOLOGY/ OPTIMIZATION/ PRODUCTION COSTS/ RISK

ABA: Author

ABS: A Life Cycle Cost (LCC) model was developed for the space station propulsion system to support the requirement and configuration trade studies. The model was conceived to be flexible in its structure in order to handle the large variations in propulsion concepts with regard to propellants, hardware, space station characteristics and operational support schemes. The model categorizes LCC into four cost segments, i.e., development, production, transportation, and operational support. The methodology is described with regard to model structure, assumptions and ground rules, types of Cost Estimating Relationships (CERs) used, validation, and input/output features. Typical cost analysis results are presented to illustrate the application of the methodology. These cover several propulsion concepts using hydrazine and oxygen/hydrogen as propellants. A comparison is made with previously published cost data by JPL, and the cost differences are explained. The methodology includes cost risk, and a description of the risk approach and the different elements of risk are provided.

....

86A21872# ISSUE 8 PAGE 1125 CATEGORY 83 84/00/00 5 PAGES In FRENCH UNCLASSIFIED DOCUMENT

UTTL: Life cycle cost and availability in military aeronautics

AUTH: A/LESUEUR, F.; B/DEMOMENT, A.; C/ECK, R.

PAA: A/(Avions Marcel Dassault-Breguet Aviation, Division Systemes d'Armes, Saint-Cloud, France) ; B/(Crouzet, S.A., Division Aerospatiale, Valence, France); C/(Societe Francaise d'Equipements pour la Navigation Aerienne, Division Pilotage et Systemes, Velizy-Villacoublay, France)

CIO: FRANCE

IN: International Colloquium on Reliability and Maintainability, 4th, Tregastel, France, May 21-25, 1984, Proceedings. Volume 2 (A86-21851 08-38). Lannion, France, Centre National d'Etudes des Telecommunications, 1984, p. 455-459. In French. Research supported by the Service Technique des Telecommunications et des Equipements Aeronautiques.

MAJS: / *AVAILABILITY/ *LIFE CYCLE COSTS/ *MILITARY AIRCRAFT/ *RELIABILITY ANALYSIS / *SYSTEM EFFECTIVENESS/ *WEAPON SYSTEM MANAGEMENT

MINS: / MAINTENANCE/ MARKOV PROCESSES/ MATHEMATICAL MODELS

ABA: G.R.

ABS: The present study is concerned with an approach to evaluate the efficiency of a weapons system. A life cycle cost model adapted to the French Air Force is considered, taking into account the costs for study and development, acquisition, and operation. The relative effect of the different parameters is discussed. The concept of operational availability is explored, and the different factors for modelling it are analyzed. Attention is given to hypotheses and limits, the various parts of a mission, the weapons system, maintenance, and aspects of modelling. It is pointed out that the two model concepts for life cycle cost and operational availability represent factors which can be used separately and jointly in the evaluation of a weapons system.
....

86A10929# ISSUE 1 PAGE 69 CATEGORY 66 RPT#: AIAA PAPER 85-3056 85/10/00 6 PAGES UNCLASSIFIED DOCUMENT COPYRIGHT

UTTL: Logistics considerations for design engineers

AUTH: A/LAUBER, F. J.

PAA: A/(McDonnell Douglas Astronautics Co., St. Louis, MO)

CIO: UNITED STATES; AIAA, AHS, and ASEE, Aircraft Design Systems and Operations Meeting, Colorado Springs, CO, Oct. 14-16, 1985. 6 p.

MAJS: / *COST REDUCTION/ *DESIGN ANALYSIS/ *LIFE CYCLE COSTS/ *LOGISTICS/ * OPTIMIZATION/ *WEAPON SYSTEMS

MINS: / DEFENSE PROGRAM/ FIGHTER AIRCRAFT/ MISSILES/ SPACECRAFT

ABA: Author

ABS: Designers of weapon systems are facing new government emphasis on providing readiness and support for new designs at an affordable and balanced life-cycle cost. Readiness and support will now receive comparable emphasis with performance, cost and schedule as a criterion for evaluating programs. To help designers adjust to this new emphasis, this paper defines logistic support, describes associated costs for operating and supporting weapon systems, and identifies the timing required to integrate support considerations into the design process. With this knowledge, designers can call for logistics assistance in the same manner that they now call for other Systems Engineering expertise to optimize the final design configuration.
....

85N30966# ISSUE 19 PAGE 3379 CATEGORY 81 RPT#: AD-A153730 LMI-RE403 CNT#: MDA903-81-C-0166 85/01/00 44 PAGES UNCLASSIFIED DOCUMENT

UTTL: Producibility Engineering and Planning (PEP): Program management guidelines

TLSP: Final Report, Nov. 1983 - Dec. 1984

AUTH: A/ADLER, F. L.; B/ALDUCIN, D. G.; C/GLASS, D. V.; D/GUNKEL, R. A.

CORP: Logistics Management Inst., Bethesda, Md. AVAIL.NTIS

SAP: HC A03/MF A01

CIO: UNITED STATES

MAJS: / *ACQUISITION/ *MANAGEMENT PLANNING/ *MANUFACTURING/ *PRODUCTION ENGINEERING / *WEAPON SYSTEMS

MINS: / AIR LAUNCHING/ ASSEMBLING/ COSTS/ CRUISE MISSILES/ FABRICATION/ LOGISTICS

ABA: GRA

ABS: Weapon systems and equipment are not always designed for economical fabrication, assembly, inspection, and testing with available production techniques. As a result, deliveries are often late and costs exceed expectations. Production suffers because producibility is not considered early enough during design and because production planning during development is inadequate. We propose guidelines that will provide managers of weapons system programs with a practical approach to developing, executing and funding individual PEP programs. To get the most out of PEP, we recommend that the program manager focus on producibility at the very start of the program and conduct a PEP program that balances design and producibility and incorporates

demonstrations of advanced manufacturing processes. During full-scale development, he should carryout out a PEP program that designs and demonstrates production tooling, facilities, and manufacturing methods. We found that when requirements and funding are sound, such as in the F-16 and Air-Launched Cruise Missile programs, a good PEP program can smooth transition from development to production.

....

85A45150# ISSUE 21 PAGE 3191 CATEGORY 83 84/00/00 6 PAGES UNCLASSIFIED DOCUMENT

UTTL: A Comparison of Various Life Cycle Cost Models — in Avionics Systems Acquisition

AUTH: A/WELCH, L. R.

PAA: A/(USAF, Avionics Systems Div., Wright-Patterson AFB, OH)

CIO: UNITED STATES

IN: NAECON 1984; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 21-25, 1984. Volume 2 (A85-44976 21-01). New York, IEEE, 1984, p. 1287-1292.

MAJS: / *AVIONICS/ *COST ANALYSIS/ *LIFE CYCLE COSTS/ *MAINTAINABILITY/ *RELIABILITY ENGINEERING

MINS: / AIRCRAFT ENGINES/ AIRFRAMES/ MODELS

ABA: Author

ABS: Life Cycle Cost (LCC) prediction has become an important step in the acquisition of avionics systems. Many models have been developed in an attempt to predict a system's LCC early in the acquisition process. This paper presents a synopsis of various LCC models which have been developed: the Reliability, Maintainability and Cost Model (RMCM), the Freiman Analysis of Systems Technique Equipment Model (FAST-E), the Programmed Review of Information for Costing and Evaluation (PRICE) Model, the TI-59 Handheld Calculator Aircraft Top Level Life Cycle Cost (TI-59 ATL2C2) Model, and the Avionics Laboratory Predictive Operations and Support (ALPOS) Cost Model. Each synopsis discusses important aspects of the model, including a description of the model, a summary of model inputs and outputs, and the accessibility of the model. A table comparing the various characteristics of the models are also presented.

....

85A42678 ISSUE 20 PAGE 3019 CATEGORY 83 RPT#: MBB-UA-842-84-OE 84/10/00 49 PAGES In GERMAN UNCLASSIFIED DOCUMENT DCAF A070087 COPYRIGHT

UTTL: Life-cycle-cost-oriented system design in weapon technology

AUTH: A/FEIERLEIN, J.

PAA: A/(Messerschmitt-Boelkow-Blohm GmbH, Ottobrunn, West Germany)

CIO: GERMANY,FEDERAL REPUBLIC OF; Deutscher Logistiker Kongress, Berlin, West Germany, Oct. 24-26, 1984, Paper. 49 p. In German.

MAJS: / *BUDGETING/ *COST ANALYSIS/ *LIFE CYCLE COSTS/ *WEAPON SYSTEMS

MINS: / DESIGN TO COST/ WEST GERMANY

ABA: T.K.

ABS: The importance of life-cycle costs (LCCs) in the planning of military-equipment budgets is discussed, and techniques for limiting LCCs beginning in the design phase are proposed, with a focus on the situation in West Germany. It is pointed out that the steep increase in military-systems budgets since 1955 has been driven mainly by LCCs rather than by the development and procurement costs, and the main factors contributing to LCCs (maintaining availability, maintaining a staff of trained personnel, and peacetime operations) are examined, taking both technical and logistic/organizational factors into account. The application of computer models such as PRICE and ON COSTS to generate long-term predictions of LCCs from design inputs is considered in detail and illustrated with diagrams and flow charts, and the consistent implementation of an LCC-based strategy is recommended.

....

84X78919# CATEGORY 1 RPT#: AD-B084743L AFWAL-TR-78-40-VOL-6 CNT#: F33615-82-C-3017 84/01/00 170 PAGES UNCLASSIFIED DOCUMENT US GOV AGENCIES

JTTL: Modular Life Cycle Cost Model (MLCCM) for advanced aircraft systems.

Phase III. Volume 6: Data base Update/Maintenance/Refinement. User's manual

TLSP: Technical Report, Jul. 1982 - Jan. 1984

AUTH: A/PULITO, V.; B/DENNIS, L.; C/HERZBERG, J.; D/WOO, W.

CORP: Grumman Aerospace Corp., Bethpage, N.Y.

CIO: UNITED STATES; Wright-Patterson AFB, Ohio AFWAL

MAJS: / *AERONAUTICAL ENGINEERING/ *AIRCRAFT DESIGN/ *COST ESTIMATES/ *DATA BASE MANAGEMENT SYSTEMS/ *LIFE CYCLE COSTS/ *MODULES/ *PREDICTION ANALYSIS TECHNIQUES/ *USER MANUALS (COMPUTER PROGRAMS)

MINS: / COST ANALYSIS/ DATA BASES/ MAINTENANCE/ MATHEMATICAL MODELS/ SENSITIVITY / TRADEOFFS

....

84N31062# ISSUE 20 PAGE 3318 CATEGORY 83 RPT#: AD-A142387 84/03/00 15 PAGES UNCLASSIFIED DOCUMENT

UTTL: Improving system affordability

AUTH: A/RIEGLE, N. N.

CORP: Naval Sea Systems Command, Washington, D.C. AVAIL.NTIS

SAP: HC A02/MF A01

CIO: UNITED STATES; Presented at the 21st Ann. Tech. Symp. of the Assoc. of Science and Engr. of the Naval Sea Systems Command, Washington, D.C., 1984

MAJS: / *ACQUISITION/ *COST ANALYSIS/ *ELECTRONIC EQUIPMENT/ *GOVERNMENT PROCUREMENT / *LIFE CYCLE COSTS/ *RELIABILITY/ *STANDARDIZATION/ *WEAPON SYSTEMS

MINS: / COMPUTER GRAPHICS/ COST EFFECTIVENESS/ COSTS/ ECONOMIC ANALYSIS/ IMPACT/ LOGISTICS/ MAINTENANCE/ MARINE TECHNOLOGY/ QUALITY CONTROL/ SERVICE LIFE/ WATER VEHICLES

ABA: GRA

ABS: This paper is an announcement of the expansion of the Navy's Standard Electronic Module Program (SEM) into a larger more comprehensive program to be known as SHARP for Standard Hardware Acquisition & Reliability Program. The paper is intended to discuss the factors which impact cost in all phases of the program's life; a common sense look at what major cost drivers are, and what can be done to control them. The paper will analyze standardization, quality, reliability, testability, and repairability with a look at their impacts on Navy life cycle costs. Special emphasis will be placed on the ability of standardization programs to adopt new technologies. In this day of increased costs and restriction of funds, it is imperative that weapons systems developers recognize the full impact of their efforts on overall life cycle costs and not concentrate solely on the development phase.

....

84N26962# ISSUE 17 PAGE 2652 CATEGORY 32 82/00/00 5 PAGES UNCLASSIFIED DOCUMENT DCAF E070178

UTTL: The life cycle cost of integrated logistic support

AUTH: A/FLORIO, U. G.

CORP: Selenia Industrie Associate S.p.A., Rome (Italy). CSS: (Naval System Div.) AVAIL.NTIS

SAP: HC A03/MF A01 In its Rivista Tec. Selenia, Vol. 8, No. 1 p 1-5 (SEE N84-26961 17-32)

CIO: ITALY

MAJS: / *COST EFFECTIVENESS/ *LIFE CYCLE COSTS/ *LOGISTICS/ *MAINTENANCE

MINS: / FINANCIAL MANAGEMENT/ MARKOV PROCESSES/ SPARE PARTS

ABA: Author (ESA)

ABS: Scheduling of preventive maintenance within the general context of the life cycle cost of integrated logistic support is discussed. The principal categories of support cost are considered and a procedure of optimizing the total cost for the evaluation of a fundamental logistic parameters is developed using Markov models. The Markov approach allows the examination of the functional relationships between system reliability, maintenance policies and the costs of integrated logistic support. The life cycle cost of the logistic support is optimized, and the results permit a correct cost/efficiency scaling of he support.

....

84N24495# ISSUE 14 PAGE 2247 CATEGORY 81 RPT#: MBB-UR-620-83-0 83/02/16 32 PAGES Partly in GERMAN and ENGLISH UNCLASSIFIED DOCUMENT DCAF E070087

UTTL: Profitability improvement of projects by early consideration of life cycle cost reduction

AUTH: A/MADAUSS, B. J.

CORP: Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). CSS: (Unternehmensbereich Raumfahrt.) AVAIL.NTIS

SAP: HC A03/MF A01

CIO: GERMANY,FEDERAL REPUBLIC OF Conf. on Ges. fuer Projektmanagement, Munich, 16 Feb. 1983

MAJS: / *COST REDUCTION/ *DESIGN TO COST/ *ECONOMIC FACTORS/ *LIFE CYCLE COSTS/ * PROJECT MANAGEMENT

MINS: / DECISION MAKING/ EFFICIENCY/ POLITICS/ PRODUCT DEVELOPMENT/ PRODUCTION MANAGEMENT/ PROJECT PLANNING

ABA: Author (ESA)

ABS: Life cycle costs, average unit fly away cost, and design to cost are defined. Program costs and program phases in the life cycle costs of a system are presented. The political decision making in the production of public goods is explained. The main milestones in and main activities during life cycle of a system are presented. The parameters influencing life cycle costs are given.

....

84N23330# ISSUE 13 PAGE 2055 CATEGORY 81 RPT#: AD-P002783 83/00/00 6 PAGES UNCLASSIFIED DOCUMENT

UTTL: A cost based acquisition planning model utilizing expert system concepts

TLSP: Final Report

AUTH: A/BUCCIARELLI, M. A.; B/ROEDER, G. L.

CORP: VTI, Inc., Dayton, Ohio. AVAIL.NTIS

SAP: HC A24/MF A01 In AF Business Research Management Center Proc. of the Fed. Acquisition Res. Symp. with Theme p 202-208 (SEE N84-23293 13-81)

CIO: UNITED STATES

MAJS: / *COMPUTER PROGRAMS/ *CONTRACT MANAGEMENT/ *COST ESTIMATES/ *EXPERT SYSTEMS/ * GOVERNMENT PROCUREMENT/ *LIFE CYCLE COSTS

MINS: / COMPUTER TECHNIQUES/ DECISION MAKING/ FORECASTING/ MAN MACHINE SYSTEMS/ MANAGEMENT PLANNING

ABA: Author (GRA)

ABS: A micro-processor based computer model utilizing expert system concepts has been developed to provide cost based acquisition planning information to the DoD acquisition community. The model, called ACROM, is a menu driven inquiry-response system wherein qualitative acquisition profile descriptions are converted, via embedded algorithms, to quantitative system acquisition cost estimates in a MIL-STD-881A Work Breakdown Structure format. The choice of one of two input modes provides for a top-down (Mode A) estimate using only six high level input parameters or a bottom-up (Mode B) estimate by characterizing each of 45 WBS elements for the system acquisition. Estimates may be accumulated by subsystem for large scale programs or by phase for total program and/or life cycle cost estimates. The model has been exercised for over 70 DoD system acquisitions and has provided relatively accurate estimates for electronic computer-based systems. It is anticipated that continued use and enhancements of the model will improve the embedded expertise in specialized acquisition areas and will provide a readily accessible and easy to use program management support tool in the critical area of system cost.

....

84A30608*# ISSUE 13 PAGE 1954 CATEGORY 62 RPT#: ASME PAPER 83-WA/AERO-11 CNT#: NAS1-14700 83/11/00 6 PAGES UNCLASSIFIED DOCUMENT

UTTL: Computer-assisted engineering data base

AUTH: A/DUBE, R. P.; B/JOHNSON, H. R.

PAA: B/(Boeing Computer Services, Inc., Seattle, WA)

CORP: Boeing Computer Services Co., Seattle, Wash.

CIO: UNITED STATES; American Society of Mechanical Engineers, Winter Annual Meeting, Boston, MA, Nov. 13-18, 1983. 6 p.

MAJS: / *AEROSPACE ENGINEERING/ *COMPUTER AIDED DESIGN/ *DATA BASE MANAGEMENT SYSTEMS/ *ENGINEERING MANAGEMENT/ *INFORMATION MANAGEMENT/ *SPACE STATIONS

MINS: / COST EFFECTIVENESS/ LIFE CYCLE COSTS/ PRODUCTION ENGINEERING/ SPACECRAFT DESIGN/ SYSTEM EFFECTIVENESS/ USER REQUIREMENTS

ABA: Author

ABS: General capabilities of data base management technology are described. Information requirements posed by the space station life cycle are discussed, and it is asserted that data base management technology supporting engineering/manufacturing in a heterogeneous hardware/ data base management system environment should be applied to meeting these requirements. Today's commercial systems do not satisfy all of these requirements. The features of an R&D data base management system being developed to investigate data base management in the engineering/manufacturing environment are discussed. Features of this system represent only a partial solution to space station requirements. Areas where this system should be extended to meet full space station information management requirements are discussed.

....

84A15212 ISSUE 4 PAGE 505 CATEGORY 83 83/08/00 5 PAGES UNCLASSIFIED DOCUMENT COPYRIGHT

UTTL: Reliability investment and life-cycle cost

AUTH: A/SEGER, J. K.

PAA: A/(Lockheed-California Co., Burbank, CA)

CIO: UNITED STATES; IEEE Transactions on Reliability (ISSN 0018-9529), vol. R-32, Aug. 1983, p. 259-263.

MAJS: / *COST ANALYSIS/ *INVESTMENTS/ *LIFE CYCLE COSTS/ *PRODUCT DEVELOPMENT/ * RELIABILITY ANALYSIS

MINS: / AVIONICS/ FAULT TOLERANCE/ RESEARCH AND DEVELOPMENT

ABA: M.S.K.

ABS: A Reliability Investment Optimization (RIO) model is discussed in order to identify the level of investment in a reliability program for a system early in the development cycle so that the system life-cycle cost is minimized. The model is constrained to consider generic types of equipment due to the early stage of consideration, and must substantiate the funding of reliability programs in the system development phase. Reliability growth, i.e., changes in reliability over time, depends on the thoroughness and intensity of the reliability program. The program comprises reliability prediction, identification of failure modes, effects analysis, and design surveillance, followed by part standardization, screening, and vendor control. LCC studies cover the R&D and development, procurement, and operations and support phases. RIO is applied to evaluate the fractional change in LCC at particular levels of the reliability program investment.

....

83A49578# ISSUE 24 PAGE 3543 CATEGORY 1 RPT#: AIAA PAPER 83-2448 83/10/00 7 PAGES UNCLASSIFIED DOCUMENT COPYRIGHT

UTTL: Avionics built-in-test effectiveness and life cycle cost

AUTH: A/PALAZZO, C.; B/ROSENFELD, M.

PAA: B/(Grumman Aerospace Corp., Bethpage, NY)

CIO: UNITED STATES; American Institute of Aeronautics and Astronautics, Aircraft Design, Systems and Technology Meeting, Fort Worth, TX, Oct. 17-19, 1983. 7 p.

MAJS: / *AVIONICS/ *ELECTRONIC EQUIPMENT TESTS/ *LIFE CYCLE COSTS/ *MILITARY TECHNOLOGY/ *SYSTEM EFFECTIVENESS

MINS: / COMPONENT RELIABILITY/ ERROR ANALYSIS/ PERFORMANCE TESTS/ WEAPON SYSTEMS

ABA: Author

ABS: Results of an investigation into the effectiveness of built-in-test (BIT) on aircraft weapon systems and its impact on operational assessability and life cycle cost (LCC) are presented herein. BIT effectiveness was found to be high in current operational systems although errors in data collection and interpretation precluded highly accurate measurements. Low BIT effectiveness had a negligible effect on logistic support costs (LSC), particularly for avionic units with moderate to high reliabilities. It was concluded that a major reason for improving BIT effectiveness was to increase its ability to determine the status of mission essential subsystems (i.e., increase operational assessability).

....

83A48334# ISSUE 23 PAGE 3513 CATEGORY 81 RPT#: AIAA PAPER 83-2451 83/10/00 10 PAGES UNCLASSIFIED DOCUMENT

UTTL: Life cycle cost management - An engineer's view

AUTH: A/PETTIGREW, J. L.

PAA: A/(USAF, Aeronautical Systems Div., Wright-Patterson AFB, OH)

CIO: UNITED STATES; American Institute of Aeronautics and Astronautics, Aircraft Design, Systems and Technology Meeting, Fort Worth, TX, Oct. 17-19, 1983. 10 p.

MAJS: / *FINANCIAL MANAGEMENT/ *LIFE CYCLE COSTS/ *VALUE ENGINEERING/ *WEAPON SYSTEMS

MINS: / MILITARY AIRCRAFT

ABA: G.R.

ABS: Questions concerning the commitment to improving affordability are discussed, taking into account the use of basic tools of statistical analysis, an approach established by the Air Force Systems Command for developing and stabilizing the scope of all programs, and affordability as the real key to justifying a weapons system. Attention is also given to the economic future with the effect of compounding inflation, the cost of a tactical aircraft compared to inflation, the entropy of affordability, the entropy of specialization, the life cycle cost (LCC), the cost of improving affordability, aspects of feedback in system engineering, engineering for supportability, and questions regarding the accountability for the future today.

....

83A43748 ISSUE 20 PAGE 3056 CATEGORY 83 RPT#: SAWE PAPER 1479 82/05/00 17 PAGES UNCLASSIFIED DOCUMENT COPYRIGHT

UTTL: Life cycle cost applications to conceptual designs

AUTH: A/EBERL, R. J.

PAA: A/(Grumman Aerospace Corp., Bethpage, NY)CIO: UNITED STATES; Society of Allied Weigh Engineers, Annual Conference, 41st, San Jose, CA, May 17-19, 1982. 17 p.

MAJS: / *AIRCRAFT DESIGN/ *DESIGN TO COST/ *FIGHTER AIRCRAFT/ *LIFE CYCLE COSTS

MINS: / COST ANALYSIS/ FUNCTIONAL DESIGN SPECIFICATIONS/ WEAPON SYSTEMS/ WEIGHT ANALYSIS

ABA: M.S.K.

ABS: A parametric approach to a life cycle cost (LCC) model for government military aircraft acquisition and operations is resented. The procedure takes into account the parameters which affect the weights, performance, reliability, and design of the aircraft, including all operations and support costs. Program segments are defined for the aircraft hardware, in-service operational costs, and the complexity of the design mission. Sizing the aircraft using computerized techniques permits rapid evaluations of tradeoffs between various performance parameters and vehicle configurations. The LCC inputs comprise considerations of cost and design related factors, engine details, avionics capabilities, and operations, support, and mission features.Estimations are also made of inflation, the cost of borrowing, and the timing of future disbursements.

....

82A14787 ISSUE 4 PAGE 608 CATEGORY 81 81/00/00 6 PAGES UNCLASSIFIED DOCUMENT COPYRIGHT

UTTL: DBMS - A Tool for System Life Cycle Management

AUTH: A/SAIDMAN, D. L.

PAA: A/(Westinghouse Electric Corp., Hunt Valley, MD)

CIO: UNITED STATES

In: NAECON 1981; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 19-21, 1981. Volume 2. (A82-14676 04-01) New York, Institute of Electrical and Electronics Engineers, Inc., 1981, p. 903-908.

MAJS: / *COMPUTER SYSTEMS PROGRAMS/ *DATA BASES/ *DATA MANAGEMENT/ *LIFE CYCLE COSTS / *WEAPON SYSTEMS

MINS: / COMPUTER SYSTEMS DESIGN/ COMPUTERIZED SIMULATION/ TECHNOLOGY ASSESSMENT

ABA: B.J.

ABS: State-of-the-art implementations of computer software, known as data base management systems (DBMS), now offer the potential to effectively manage a variety of loistics-related data. This paper traces the evolution of data management, leading to the creation of DBMS, and the application of DBMS in logistics. Several Westinghouse DBMS applications in logistics and LCC are discussed, including the use of the System 2000 DBM to manage F-16 data and the use of the IMAGE DBMS in the Westinghouse Electronic Repair Center.

....

81N11907# ISSUE 2 PAGE 277 CATEGORY 81 80/07/00 15 PAGES UNCLASSIFIED DOCUMENT

UTTL: Design to life cycle cost research

AUTH: A/CARLSON, F. T.

CORP: Boeing Aerospace Co., Seattle, Wash. AVAIL.NTIS

SAP: HC A15/MF A01 In AGARD Design to Cost and Life Cycle Cost 15 p (SEE N81-11902 02-81)

CIO: UNITED STATES

MAJS: / *COST ESTIMATES/ *LIFE CYCLE COSTS/ *LOGISTICS/ *PRODUCTION PLANNING/ *VALUE ENGINEERING

MINS: / AIRCRAFT INDUSTRY/ MAINTENANCE/ PREDICTION ANALYSIS TECHNIQUES/ WEAPONS INDUSTRY

ABA: E.D.K.

ABS: Design to life cycle cost research applied to the area of logistics systems is discussed with a look at history data for typical aircraft systems. Deficiencies in systems operations and support are identified and described. Methods of assessing the cost, risk, and program application are discussed. Areas of emphasis, cost drivers, and their impacts are shown. It is determined that many deficiencies in the ownership of systems do not relate to program plans. Resolution by future technology advances must be aimed toward elimination of manpower, material, and program causative factors through research of logistics subsystems, i.e., inspections, material distribution, people use, and logistics networks.

....

81A30295# ISSUE 12 PAGE 2070 CATEGORY 81 80/00/00 2 PAGES UNCLASSIFIED DOCUMENT

UTTL: The significance of cost in the Air Force Acquisition Logistics Division

AUTH: A/MCCARTHY, J. R.

PAA: A/(USAF, Acquisition Logistics Div., Wright-Patterson AFB, Ohio)

CIO: UNITED STATES

In: NAECON 1980; Proceedings of the National Aerospace and Electronics Conference, Dayton, Ohio, May 20-22, 1980. Volume 2. (A81-30226 12-04) New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 668, 669.

MAJS: / *COST ESTIMATES/ *LIFE CYCLE COSTS/ *LOGISTICS/ *MILITARY AIRCRAFT/ *WEAPON SYSTEMS

MINS: / AIRCRAFT MAINTENANCE

ABA: (Author)

ABS: The Air Force Acquisition Logistics Division was organized at Wright-Patterson Air Force Base about three years ago. It has two basic missions - improving the operational readiness of the United States Air Force and reducing the life cycle costs of Air Force weapon systems. Accurate cost estimates early in the life cycle of a weapon system are required if the necessary information is to be available for management decisions which will lead to the reduction of total costs.

....

No.: M5 **Title:** Design to Cost

Operational Requirement:

Assure that adequate Design-to-Cost budget is allocated to operational considerations such as maintainability / supportability.

Rationale:

The history of previous programs is fraught with Life Cycle Cost extravagances casued by inadequate front-end budget considerations for operations related design.

Technology References:

NASA/RECON: 84N19129, 81N29023, 81N11907

DoD directives 5000.1 and 5000.28.

See also M4 (Life Cycle Costs).

84N19129# ISSUE 9 PAGE 1398 CATEGORY 81 RPT#: AD-A136020 CNT#: DA903-82-C-0339 83/10/03 36 PAGES UNCLASSIFIED DOCUMENT

UTTL: System engineering management guide

CORP: Lockheed Missiles and Space Co., Sunnyvale, Calif.

CSS: (Space Systems Div.) AVAIL.NTIS

SAP: HC A11/MF A01

CIO: UNITED STATES

MAJS: / *MANAGEMENT PLANNING/ *OPTIMIZATION/ *SYSTEM EFFECTIVENESS/ *SYSTEMS ENGINEERING/ *SYSTEMS MANAGEMENT/ *WEAPON SYSTEMS

MINS: / CONFIGURATION MANAGEMENT/ DESIGN TO COST/ LIFE CYCLE COSTS/ LOGISTICS/ MANUFACTURING

ABA: GRA

ABS: The primary objective of this Guide is to provide a working familiarity with System Engineering Management. System Engineering has gained increasing attention since its recognition following World War II. This has been stimulated by the increasing cost and technical complexity of development and acquisition programs. Some of this attention is no doubt due to large program failures which possibly could have been avoided, or at least mitigated, through the use of System Engineering. In today's acquisition environment it is not sufficient to apply only basic engineering principles. The complexity of a modern major weapon system requires conscious application of System Engineering principles and concepts to ensure producible, operable, and supportable systems that satisfy mission requirements. The Guide covers the development of a system from inception to operational deployment and use. It is divided into five modules: System Engineering Management; System Definition; Configuration Definition and Management; Technical Performance Achievement; and Operational Feasibility.

....

81N29023# ISSUE 19 PAGE 2711 CATEGORY 81 RPT#: AGARD-AR-165 ISBN-92-835-1387-8 AD-A101447 81/05/00 30 PAGES UNCLASSIFIED DOCUMENT COPYRIGHT Report previously announced as N81-11902

UTTL: Design to cost and life cycle cost

AUTH: A/LAMAR, W. E.

CORP: Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).

CSS: (Flight Mechanics Panel.) AVAIL.NTIS

SAP: HC A03/MF A01

CIO: UNITED STATES

MAJS: / *AIRCRAFT PRODUCTION COSTS/ *COST REDUCTION/ *DESIGN TO COST/ *LIFE CYCLE COSTS/ *SPECIFICATIONS

MINS: / CONTRACT INCENTIVES/ COST ESTIMATES/ GOVERNMENT/INDUSTRY RELATIONS/ SYSTEMS ENGINEERING

ABA: A.R.H.

ABS: Summaries of the papers delivered at the symposium, an account of the closing round table discussion, and an extensive listing of conclusions and recommendations in the area of design to cost and life cycle costing are presented. The sessions covered: (1) life cycle methodology and its relation to relation to specifications and requirements; (2) impact of life cycle costs analyses on total system design; (3) cost control of operations and support; and (4) life cycle cost of subsystems and components. The papers delivered at each session are listed.

....

81N11907# ISSUE 2 PAGE 277 CATEGORY 81 80/07/00 15 PAGES UNCLASSIFIED DOCUMENT

UTTL: Design to life cycle cost research

AUTH: A/CARLSON, F. T.

CORP: Boeing Aerospace Co., Seattle, Wash. AVAIL.NTIS

SAP: HC A15/MF A01 In AGARD Design to Cost and Life Cycle Cost 15 p (SEE N81-11902 02-81)

CIO: UNITED STATES

MAJS: / *COST ESTIMATES/ *LIFE CYCLE COSTS/ *LOGISTICS/ *PRODUCTION PLANNING/ *VALUE ENGINEERING

MINS: / AIRCRAFT INDUSTRY/ MAINTENANCE/ PREDICTION ANALYSIS TECHNIQUES/ WEAPONS INDUSTRY

ABA: E.D.K.

ABS: Design to life cycle cost research applied to the area of logistics systems is discussed with a look at history data for typical aircraft systems. Deficiencies in systems operations and support are identified and described. Methods of assessing the cost, risk, and program application are discussed. Areas of emphasis, cost drivers, and their impacts are shown. It is determined that many deficiencies in the ownership of systems do not relate to program plans. Resolution by future technology advances must be aimed toward elimination of manpower, material, and program causative factors through research of logistics subsystems, i.e., inspections, material distribution, people use, and logistics networks.

....

No: M6 **Title:** ULCE (Unified Life Cycle Engineering)

Operations Requirement:

Use Unified Life Cycle Engineering (ULCE). This is a design engineering environment in which computer-aided design technology is used to continually assess and improve the quality of a product during the active design phases as well as throughout its entire life cycle. This is accomplished by integrating and optimizing design attributes for producibility and supportability with design attributes for performance, operability, cost, and schedule.

Rationale:

No integrated methodology or discipline has been used to provide advantageous computerized integration of producibility and supportability with performance, cost and schedule.

Sample Concept:

Implement Unified Life Cycle Engineering (ULCE) system to provide birth-to-death unified design environment.

USAF Project Forecast II's ULCE (PT-32) provides the environment for all design attributes (e.g. Performance, producibility, support, quality, cost, schedule, etc.) to be appropriately addressed during the design process taking maximum advantage of computer techniques. Provide for computerized approval/concurrence control of requirements, procedures, and anomaly close-outs as part of ULCE; also provide for risk management, configuration control, mission/range support, flight readiness reviews, resolution of in-flight anomalies. etc.

Technology Requirement:

Continued development of ULCE.

Technology References:

SGOE/T Study Report, "SOCH Appendices", Draft dated 9/8/87.

No.: M7 **Title:** Risk Management

Operational Requirement:

The unmanned ALS program requires compliance with a non-emotional, well-engineered risk management program.

Rationale:

Trying to provide a "zero-risk" launch program is like dividing cost by zero.

The emotionalism and overreaction to the loss of Challenger, has impacted the STS program far more than a logical risk management program. In addition to the two plus years of manifests that were lost, future vehicle processing time has tripled from the pre-Challenger goal.

Launch readiness decisions must be made by technically qualified managers based on a disciplined test and qualification requirements compliance database.

Sample Concept:

Effective use of the Design/Build Team concept which utilizes the knowledge and experience of all disciplines should contribute significantly to an effective risk management program.

Use of the Unified Life Cycle Engineering (ULCE) concept will provide the tools to follow through on the risk management program.

Vehicle systems that are fault tolerant and closely monitor health of avionics, mechanical systems and structures.

Technology Requirement:

Stringent use of the Design/Build Team concept.

Further development of the ULCE modules.

Fault tolerant avionics

Comprehensive vehicle health monitoring system to include avionics, mechanical systems and structures.

Technology References:

NASA/RECON: 84N19124

See also M2, M6, A1, A2, S2.

84N19124# ISSUE 9 PAGE 1397 CATEGORY 81 RPT#: AD-A136230 83/07/15 292 PAGES UNCLASSIFIED DOCUMENT

UTTL: Management of risk and uncertainty in systems acquisition: Proceedings of the 1983 Defense Risk and Uncertainty Workshop

AUTH: A/WILLIAMS, R. F.; B/ABEYTA, R. D.

CORP: Defense Systems Management School, Fort Belvoir, Va. AVAIL.NTIS

SAP: HC A13/MF A01

CIO: UNITED STATES; Workshop held in Fort Belvoir, Va., 13-15 Jul. 1983

MAJS: / *CONFERENCES/ *INFORMATION DISSEMINATION/ *RISK/ *WEAPON SYSTEMS

MINS: / ACQUISITION/ COST ESTIMATES/ DEFENSE PROGRAM/ GOVERNMENT PROCUREMENT/ LOGISTICS/ PANELS/ TECHNOLOGY ASSESSMENT

ABA: GRA

ABS: The general objectives of this workshop were to report on state of the art techniques and exchange information on risk and uncertainty within the Department of Defense Panel Sessions covered these topics: methods and models; budgeting and contracting risk; computer aids in decision making; management view of acquisition risk; behavior under risk and uncertainty; risk analysis; advanced theory; and issues in risk and uncertainty.

....

No.: M8 **Title:** Reliability / Operability

Operational Requirement:

To provide a vehicle with adequate system availability, resiliency, and schedule dependability to eliminate schedule impact and resulting process cost (i.e. manpower and overtime).

Rationale:

The processing history at ETR and KSC of both expendable and recoverable vehicles support this requirement. Included below are typical items which surfaced during Phase 1 of this Study.

Sample Concept:

1. Launch vehicles must be designed with very large performance margins and system redundancy:
   - To allow operation well within design margins.
   - To ensure mission completion despite hardware failure.
   - To require less pre-launch testing.
2. Systems and components must be simplified and ruggedized to reduce failure modes.
3. Performance margins must be increased and more extensive qualification testing performed to increase MTBF.
4. Designs must include status monitoring features so that system health can be easily and quickly determined.
5. Performance must be completely mapped as a function of time-in-service so that maintenance and replacement can be planned to minimize operational impacts.

Technology Requirement:

None

Technology References:

NASA/RECON : 86X70507, 86N28011, 86N24579, 86N21425, 86N20054, 86A22393, 86A22391, 85X72180, 84N23813, 84A15215, 84A15212

SGOE/T Final Report, Phase 1, 4 May 1987

86X70507# CATEGORY 38 RPT#: AD-B094246L AD-E900490 USACSTA-6156 85/03/00 207 PAGES UNCLASSIFIED DOCUMENT US GOV AGENCIES

UTTL: Methodology investigation of RAMSAT (Reliability, Availability, Maintainability Statistic Analysis Technique) feasibility study

TLSP: Final Report, Apr. - Dec. 1984

AUTH: A/SANGIINETTE, W. P.

CORP: Army Combat Systems Test Activity (Provisional), Aberdeen Proving Ground, Md. MFC: 00

CIO: UNITED STATES

MAJS: / *AIR DEFENSE/ *DATA ACQUISITION/ *FEASIBILITY ANALYSIS/ *INFORMATION SYSTEMS / *LOGISTICS/ *RELIABILITY ANALYSIS/ *REQUIREMENTS

MINS: / AVAILABILITY/ COLLECTION/ MAINTAINABILITY/ TRAILERS

....

86N28011# ISSUE 18 PAGE 2976 CATEGORY 81 RPT#: AD-A165520 85/12/00 148 PAGES UNCLASSIFIED DOCUMENT

UTTL: Controlling life-cycle cost: A management perspective

TLSP: M.S. Thesis

AUTH: A/PORTER, D. L.

CORP: Naval Postgraduate School, Monterey, Calif. AVAIL.NTIS

SAP: HC A07/MF A01

CIO: UNITED STATES

MAJS: / *COST ESTIMATES/ *ECONOMICS/ *LIFE CYCLE COSTS/ *LOGISTICS/ *PERSONNEL/ * PROCUREMENT MANAGEMENT

MINS: / ARMED FORCES (UNITED STATES)/ GOVERNMENT PROCUREMENT/ NAVY/ PROCUREMENT POLICY

ABA: GRA

ABS: The objective of this thesis is to examine the obstacles which are preventing the Navy from realizing the full economic advantage of a total cost management program for aviation support equipment. The research has shown that Navy program managers are not fully committed to managing life-cycle cost nor is it considered early enough in the procurement process to influence design. To improve the life-cycle cost management effort, existing policies and provisions included in DoD Directives should be applied to aviation support equipment. More emphasis should be placed on the RFP as a means of communicating the Navy's concerns about controlling cost and adequate information should be provided to the contractor to be used in developing realistic cost estimates. Finally, life-cycle cost should be elevated to the level of unit-production cost, schedule and performance and made a mandatory source selection criterion.

....

86N24579# ISSUE 14 PAGE 2395 CATEGORY 83 RPT#: AD-A162204 85/09/20 42 PAGES UNCLASSIFIED DOCUMENT

UTTL: Impact of Reliability/Maintainability (R/M) on logistics costs for USAF aircraft

AUTH: A/SHERBO, A. J.; B/LOCHBAUM, J.

CORP: Department of the Air Force, Washington, D.C. AVAIL.NTIS

SAP: HC A03/MF A01

CIO: UNITED STATES; Presented at the 19th Annual Department of Defense Cost Analysis Symposium, Leesburg, Va., 17-20 Sep. 1985

MAJS: / *COST ESTIMATES/ *IMPACT/ *LOGISTICS/ *LOW COST/ *MAINTAINABILITY/ *MILITARY AIRCRAFT/ *RELIABILITY

MINS: / METHODOLOGY/ WEAPON SYSTEMS

ABA: GRA

ABS: The purpose of this study is to develop some cost estimating relationships (CERs) that supports the contention that higher R&M results in lower logistics support costs, and can be used in a variety of ways. Our primary need is a methodology that enables us to quantify the impact of R&M changes or levels on existing and new aircraft in terms of logistics support costs. The CERs we are searching for need to be at the weapon system level as opposed to the subsystem or component level.

....

86N21425# ISSUE 11 PAGE 1882 CATEGORY 81 RPT#: ECN-158 B8478686 84/09/00 351 PAGES UNCLASSIFIED DOCUMENT DCAF E011019

UTTL: Phased mission analysis of maintained systems. A study in reliability and risk analysis

AUTH: A/TERPSTRA, K.

CORP: Netherlands Energy Research Foundation, Petten. AVAIL.NTIS

SAP: HC A16/MF A01

CIO: NETHERLANDS

MAJS: /*MAINTENANCE/ *MISSION PLANNING/ *PREDICTION ANALYSIS TECHNIQUES/ *RELIABILITY ANALYSIS/ *RISK

MINS: / COMPONENT RELIABILITY/ FAILURE ANALYSIS/ MAINTAINABILITY/ RELIABILITY ENGINEERING/ SERVICE LIFE/ SYSTEM FAILURES

ABA: Author (ESA)

ABS: A methodology that analyzes phased missions and all branches of an event tree and can take into account repair of the system during its mission and the effects of component models with general distributed lifetimes and repair times was developed. The introduction of the concept of period of a component makes it possible to separate the analysis of the system behavior from that of the component behavior. As a result the calculation of the probability of mission success is very simple. However, calculation of component unavailability becomes intricate, particularly if no negative exponentially distributed lifetimes and repair times are applied.

....

86N20054# ISSUE 10 PAGE 1658 CATEGORY 66 RPT#: AD-A161030 AFIT/GLM/LSQ/85S 85/09/00 132 PAGES UNCLASSIFIED DOCUMENT

UTTL: Developing source selection evaluation criteria and standards for reliability and maintainability

TLSP: M.S. Thesis

AUTH: A/HARNEN, D. E., JR.

CORP: Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. CSS: (School of Systems and Logistics.) AVAIL.NTIS

SAP: HC A07/MF A01

CIO: UNITED STATES

MAJS: / *MAINTAINABILITY/ *RELIABILITY/ *SELECTION/ *STANDARDS/ *SYSTEMS ANALYSIS/ *WEAPON SYSTEM

MINS: / CRITERIA/ DATA BASES/ GOVERNMENT PROCUREMENT/ LOGITICS/ PERSONNEL/ PLANNING

ABA: Author (GRA)

ABS: This thesis studied the development of source selection evaluation criteria and standards for reliability and maintainability. The data base consisted of information obtained during personal interviews with personnel

from Air Force Acquisition Logistics Center. Those interviewed were experienced in the development of source selection criteria and standards for reliability and maintainability. Reliability and Maintainability (R&M) issues have become the prime focus of attention within the Air Force in the development and acquisition of major weapon systems. &M considerations must be continuously addressed to insure readiness of our Air Force. A weapon system must be able to perform with consistent reliability and be designed for efficient and effective maintainability.

....

86A22393 ISSUE 8 PAGE 1057 CATEGORY 38 85/00/00 6 PAGES UNCLASSIFIED DOCUMENT COPYRIGHT

UTTL: Space station reliability

AUTH: A/BIRDSALL, C. R.; B/FRANK, H. J.

PAA: B/(Lockheed Missiles and Space Co., Inc., Sunnyvale, CA)

CIO: UNITED STATES

IN: Annual Reliability and Maintainability Symposium, Philadelphia, PA, January 22-24, 1985, Proceedings (A86-22376 08-38). New York, Institute of Electrical and Electronics Engineers, 1985, p. 197-202.

MAJS: / *FAIL-SAFE SYSTEMS/ *FAULT TOLERANCE/ *RELIABILITY ANALYSIS/ *SPACE STATIONS

MINS: / AUTONOMY/ DESIGN/ LIFE CYCLE COSTS/ MAINTAINABILITY

ABA: Author

ABS: This paper addresses the complex reliability issues of a permanent manned space station. Space station development concepts for a space vehicle service station demand state of the art approaches to crew safety, automation, Space Shuttle support, and maintenance. The paper describes a preliminary approach to application of reliability technology to future manned space systems. An effective approach to minimal cost is a difficult issue. A nearly failure free system is within the available technology, but the initial cost is high. Lower reliability, more frequent failure, more maintenance and logistic support raise operational support cost. The solution is shown to lie between the extremes of the reliability alternatives.

....

86A22391# ISSUE 8 PAGE 1056 CATEGORY 38 85/00/00 7 PAGES UNCLASSIFIED DOCUMENT

UTTL: Relating factory and field reliability and maintainability measures

AUTH: A/MACDIARMID, P. R.

PAA: A/(USAF, Rome Air Development Center, Griffiss AFB, NY)

CIO: UNITED STATES

IN: Annual Reliability and Maintainability Symposium, Philadelphia, PA, January 22-24, 1985, Proceedings (A86-22376 08-38). New York, Institute of Electrical and Electronics Engineers, 1985, p. 177-183.

MAJS: / *AIRCRAFT MAINTENANCE/ *MAINTAINABILITY/ *RELIABILITY ANALYSIS

MINS: / INDUSTRIAL PLANTS/ LOGISTICS/ MTBF

ABA: Author

ABS: This paper addresses the issue of field reliability not equaling factory reliability. It overviews Air Force and DOD policy on the issue, reviews previous works on the subject and details current Rome Air Development Center activities related to it, including a recently completed study that developed models translating contractual to operational (and vice versa) R&M parameters.

....

85X72180# CATEGORY 38 RPT#: AD-B087426L D194-30069-1 RADC-TR-84-25-VOL-1 CNT#: F30602-82-C-0071 84/02/00 125 PAGES UNCLASSIFIED DOCUMENT US GOV AGENCIES AND CONTRACTORS

UTTL: Reliability/maintainability operational parameter translation TLSP: Final Technical Report, 22 Mar. 1982 - 21 Sep. 1983

AUTH: A/HALL, R. C.; B/SCHNEIDER, R. C.; C/SMOKE, J. W.

CORP: Boeing Aerospace Co., Seattle, Wash.

CIO: UNITED STATES; Griffis AFB, N.Y. RADC

MAJS: / *CONTRACT MANAGEMENT/ *ELECTRONIC EQUIPMENT/ *MAINTAINABILITY/ *RELIABILITY / *REQUIREMENTS/ *STANDARDS

MINS: / CONTRACTS/ INDEPENDENT VARIABLES/ LOGISTICS/ MANUALS/ MATHEMATICAL MODELS/ MILITARY OPERATIONS/ PARAMETERIZATION/ PLANNING/ PREDICTIONS/ SYSTEMS MANAGEMENT

....

84N23813# ISSUE 14 PAGE 2137 CATEGORY 38 RPT#: AD-P002148 83/00/00 3 PAGES UNCLASSIFIED DOCUMENT

UTTL: Reliability in space: Program manager and user awareness

AUTH: A/ANDERSON, A. J. W.

CORP: North American Air Defense Command, Peterson AFB, Colo.

CSS: (System Control Div.) AVAIL.NTIS

SAP: HC A07/MF A01 In AF Academy Proc. of the 1983 Symp. on Mil. Space Commun. and Operations p 33-35 (SEE N84-23809 14-32)

CIO: UNITED STATES

MAJS: / *COMMUNICATION SATELLITES/ *MILITARY OPERATIONS/ *PROJECT MANAGEMENT/ * RELIABILITY ENGINEERING

MINS: / BUDGETING/ DESIGN ANALYSIS/ LIFE CYCLE COSTS/ MAINTENANCE/ QUALITY CONTROL/ USER REQUIREMENTS

ABA: Author

ABS: Space systems and satellite communications are now a reality. As these systems become more important to our military missions, we must ensure we have reliable equipment. The role of reliability is not just the responsibility of the project reliability engineer. The program manager and the user must understand the importance of the reliability program. The designers and users must have a mutual understanding of the program goals. If the engineer is the only one who can understand the system, the user will not agree it is what is needed and the program manager will not support the funding requirement.

....

84A15215 ISSUE 4 PAGE 505 CATEGORY 83 83/08/00 6 PAGES UNCLASSIFIED DOCUMENT COPYRIGHT

UTTL: Reliability cost estimation - Managerial perspectives

AUTH: A/REGULINSKI, T. L.; B/GUPTA, Y. P.

PAA: A/(Goodyear Aerospace Corp., Goodyear, AZ); B/(Manitoba, University, Winnipeg, Canada)

CIO: UNITED STATES; IEEE Transactions on Reliability (ISSN 0018-9529), vol. R-32, Aug. 1983, p. 276-281.

MAJS: / *COST ESTIMATES/ *LIFE CYCLE COSTS/ *MAINTAINABILITY/ *RELIABILITY ANALYSIS / *STATISTICAL DISTRIBUTIONS/ *SYSTEMS SIMULATION

MINS: / COMPUTERIZED SIMULATION/ MANAGEMENT PLANNING/ MATHEMATICAL MODELS/ PERFORMANCE PREDICTION/ PROBABILITY THEORY/ PROCUREMENT MANAGEMENT

ABA: Author

ABS: This paper deals with selected sources of uncertainties associated with the reliability related life cycle

costs (LCC). Some of the factors responsible for uncertainty in reliability cost estimation are identified and discussed. A practical approach to the use of Beta distribution in estimating the reliability-related costs within the LCC framework is detailed, and is illustrated using a hypothetical example. Improved estimation of reliability related LCC requires better understanding of sources of associated uncertainties and the methods of dealing explicitly with them. Numerous distributions can be used for modeling of cost variates besides the Beta demonstrated in this paper. The 3-parameter Weibull and Gamma distributions are two examples. Whichever distribution is chosen, given a sufficiently large cost data base, it is essential to test the cost variate for goodness of fit and to validate the model by appropriate test of hypothesis. However, in estimation of costs involving large capital expenditure over a period of years, the data base is not likely to be large. Lacking, then, a statistically significant sample which would allow testing for the underlying probability distribution governing the cost variate, modeling via the Beta or other appropriate distribution presents a practical alternative.

....

84A15212 ISSUE 4 PAGE 505 CATEGORY 83 83/08/00 5 PAGES UNCLASSIFIED DOCUMENT COPYRIGHT

UTTL: Reliability investment and life-cycle cost

AUTH: A/SEGER, J. K.

PAA: A/(Lockheed-California Co., Burbank, CA)

CIO: UNITED STATES; IEEE Transactions on Reliability (ISSN 0018-9529), vol. R-32, Aug. 1983, p. 259-263.

MAJS: / *COST ANALYSIS/ *INVESTMENTS/ *LIFE CYCLE COSTS/ *PRODUCT DEVELOPMENT/ * RELIABILITY ANALYSIS

MINS: / AVIONICS/ FAULT TOLERANCE/ RESEARCH AND DEVELOPMENT

ABA: M.S.K.

ABS: A Reliability Investment Optimization (RIO) model is discussed in order to identify the level of investment in a reliability program for a system early in the development cycle so that the system life-cycle cost is minimized. The model is constrained to consider generic types of equipment due to the early stage of consideration, and must substantiate the funding of reliability programs in the system development phase. Reliability growth, i.e., changes in reliability over time, depends on the thoroughness and intensity of the reliability program. The program comprises reliability prediction, identification of failure modes, effects analysis, and design surveillance, followed by part standardization, screening, and vendor control. LCC studies cover the R&D and development, procurement, and operations and support phases. RIO is applied to evaluate the fractional change in LCC at particular levels of the reliability program investment.

....

No.: M9 **Title:** Maintainability/Supportability

Operational Requirement:

Maintainability / supportability must get high priority in Design / Build Team representation.

Rationale:

Analysis of STS cost drivers in Phase 1 of this study includes, for example, documentation of some 226 maintainability issues (problems) and 104 accessibility issues. Most of these would not have occurred if adequate consideration / priority had been assigned before the design was cast in concrete.

Sample Concept:

Strong representation of maintainability and operations disciplines or Design / Build Teams.

Technology Requirement:

None.

Technology References:

NASA/RECON: 86N24579, 86N20054, 86A32095, 86A22391, 86A22380, 85X72180, 85N16743, 84N22528

86N24579# ISSUE 14 PAGE 2395 CATEGORY 83 RPT#: AD-A162204 85/09/20 42 PAGES UNCLASSIFIED DOCUMENT

UTTL: Impact of Reliability/Maintainability (R/M) on logistics costs for USAF aircraft

AUTH: A/SHERBO, A. J.; B/LOCHBAUM, J.

CORP: Department of the Air Force, Washington, D.C. AVAIL.NTIS

SAP: HC A03/MF A01

CIO: UNITED STATES; Presented at the 19th Annual Department of Defense Cost Analysis Symposium, Leesburg, Va., 17-20 Sep. 1985

MAJS: / *COST ESTIMATES/ *IMPACT/ *LOGISTICS/ *LOW COST/ *MAINTAINABILITY/ *MILITARY AIRCRAFT/ *RELIABILITY

MINS: / METHODOLOGY/ WEAPON SYSTEMS

ABA: GRA

ABS: The purpose of this study is to develop some cost estimating relationships (CERs) that supports the contention that higher R&M results in lower logistics support costs, and can be used in a variety of ways. Our primary need is a methodology that enables us to quantify the impact of R&M changes or levels on existing and new aircraft in terms of logistics support costs. The CERs we are searching for need to be at the weapon system level as opposed to the subsystem or component level.

....

86N20054# ISSUE 10 PAGE 1658 CATEGORY 66 RPT#: AD-A161030 AFIT/GLM/LSQ/85S 85/09/00 132 PAGES UNCLASSIFIED DOCUMENT

UTTL: Developing source selection evaluation criteria and standards for reliability and maintainability

TLSP: M.S. Thesis

AUTH: A/HARNEN, D. E., JR.

CORP: Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. CSS: (School of Systems and Logistics.) AVAIL.NTIS

SAP: HC A07/MF A01

CIO: UNITED STATES

MAJS: / *MAINTAINABILITY/ *RELIABILITY/ *SELECTION/ *STANDARDS/ *SYSTEMS ANALYSIS/ *WEAPON SYSTEM

MINS: / CRITERIA/ DATA BASES/ GOVERNMENT PROCUREMENT/ LOGITICS/ PERSONNEL/ PLANNING

ABA: Author (GRA)

ABS: This thesis studied the development of source selection evaluation criteria and standards for reliability and maintainability. The data base consisted of information obtained during personal interviews with personnel from Air Force Acquisition Logistics Center. Those interviewed were experienced in the development of source selection criteria and standards for reliability and maintainability. Reliability and Maintainability (R&M) issues have become the prime focus of attention within the Air Force in the development and acquisition of major weapon systems. &M considerations must be continuously addressed to insure readiness of our Air Force. A weapon system must be able to perform with consistent reliability and be designed for efficient and effective maintainability.

....

86A32095*# ISSUE 14 PAGE 1991 CATEGORY 12 RPT#: AIAA PAPER 86-9754 86/04/00 5 PAGES UNCLASSIFIED DOCUMENT

UTTL: Maintainability planning for the Space Station

AUTH: A/EGAN, G. R.

PAA: A/(NASA, Johnson Space Center, Houston, TX)

CORP: National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

CIO: UNITED STATES; AIAA, AHS, CASI, DGLR, IES, ISA, ITEA, SETP, and SFTE, Flight Testing Conference, 3rd, Las Vegas, NV, Apr. 2-4, 1986. 5 p.

MAJS: / *MAINTAINABILITY/ *SPACE MAINTENANCE/ *SPACE STATIONS

MINS: / COST ANALYSIS/ LIFE CYCLE COSTS

ABA: O.C.

ABS: The planned NASA Space Station, which is expected to have many years of on-orbit operation, for the first time confronts spacecraft designers with major questions of maintainability in design. A Maintainability Guidelines Document has been distributed to all Space Station Definition and Preliminary Design personnel of the Space Station Program Office. Trade studies are being performed to determine the most economical balance between initial (reliability) cost and life cycle cost (crew time and replacement hardware) costs.

....

86A22391# ISSUE 8 PAGE 1056 CATEGORY 38 85/00/00 7 PAGES UNCLASSIFIED DOCUMENT

UTTL: Relating factory and field reliability and maintainability measures

AUTH: A/MACDIARMID, P. R.

PAA: A/(USAF, Rome Air Development Center, Griffiss AFB, NY)

CIO: UNITED STATES

IN: Annual Reliability and Maintainability Symposium, Philadelphia, PA, January 22-24, 1985, Proceedings (A86-22376 08-38). New York, Institute of Electrical and Electronics Engineers, 1985, p. 177-183.

MAJS: / *AIRCRAFT MAINTENANCE/ *MAINTAINABILITY/ *RELIABILITY ANALYSIS

MINS: / INDUSTRIAL PLANTS/ LOGISTICS/ MTBF

ABA: Author

ABS: This paper addresses the issue of field reliability not equaling factory reliability. It overviews Air Force and DOD policy on the issue, reviews previous works on the subject and details current Rome Air Development Center activities related to it, including a recently completed study that developed models translating contractual to operational (and vice versa) R&M parameters.

....

86A22380 ISSUE 8 PAGE 1056 CATEGORY 38 85/00/00 6 PAGES UNCLASSIFIED DOCUMENT COPYRIGHT

UTTL: More accurate maintainability predictions

AUTH: A/BAKKEN, D.; B/BANGHART, J. M.

PAA: B/(Sanders Associates, Inc., Nashua, NH)

CIO: UNITED STATES

IN: Annual Reliability and Maintainability Symposium, Philadelphia, PA, January 22-24, 1985, Proceedings (A86-22376 08-38). New York, Institute of Electrical and Electronics Engineers, 1985, p. 44-49.

MAJS: / *LOGISTICS/ *MAINTAINABILITY/ *PREDICTIONS

MINS: / COMPUTER PROGRAMS

ABA: Author

ABS: Computer programs that perform the calculations to complete a maintainability prediction are in frequent use.

These programs can and should easily accommodate analysis which is not practical for manual maintainability predictions. Among the more sophisticated analysis capabilities are the handling of probabilistic task times in the calculation of task time distributions, and the ability to analyze multiple levels of repair performed at the same repair facility.

....

85X72180# CATEGORY 38 RPT#: AD-B087426L D194-30069-1 RADC-TR-84-25-VOL-1 CNT#: F30602-82-C-0071 84/02/00 125 PAGES UNCLASSIFIED DOCUMENT US GOV AGENCIES AND CONTRACTORS

UTTL: Reliability/maintainability operational parameter translation TLSP: Final Technical Report, 22 Mar. 1982 - 21 Sep. 1983

AUTH: A/HALL, R. C.; B/SCHNEIDER, R. C.; C/SMOKE, J. W.

CORP: Boeing Aerospace Co., Seattle, Wash.

CIO: UNITED STATES; Griffis AFB, N.Y. RADC

MAJS: / *CONTRACT MANAGEMENT/ *ELECTRONIC EQUIPMENT/ *MAINTAINABILITY/ *RELIABILITY / *REQUIREMENTS/ *STANDARDS

MINS: / CONTRACTS/ INDEPENDENT VARIABLES/ LOGISTICS/ MANUALS/ MATHEMATICAL MODELS/ MILITARY OPERATIONS/ PARAMETERIZATION /PLANNING /PREDICTIONS /SYSTEMS MANAGEMENT

....

85N16743# ISSUE 8 PAGE 1064 CATEGORY 1 84/10/00 15 PAGES UNCLASSIFIED DOCUMENT

UTTL: Maintainability: An ILS Effort to Manipulate LCC

AUTH: A/BOEHM, M.

CORP: AEG-Telefunken, Ulm (West Germany). AVAIL.NTIS

SAP: HC A13/MF A01; In AGARD Design for Tactical Avionics Maintainability 15 p (SEE N85-16731 08-01)

CIO: GERMANY,FEDERAL REPUBLIC OF

MAJS: / *AVIONICS/ *MAINTAINABILITY/ *MAINTENANCE

MINS: / DECISION MAKING/ LIFE CYCLE COSTS/ OPTIMIZATION/ RADAR

ABA: R.J.F.

ABS: The concept of maintainability is discussed. The importance of maintainability in controling the life cycle costs of avionics and radar equipment is evaluated.

....

84N22528# ISSUE 13 PAGE 1925 CATEGORY 1 RPT#: AD-A138587 AFWAL-TR-83-1183 CNT#: F33615-81-C-1517 AF PROJ. 2003 83/12/00 323 PAGES UNCLASSIFIED DOCUMENT

UTTL: Integrated testing and maintenance technologies

TLSP: Final Technical Report, 25 Sep. 1981 - 15 Sep. 1983

AUTH: A/DENNEY, R. O.; B/PARTRIDGE, M. J.; C/WILLIAMS, R. B.

CORP: Boeing Aerospace Co., Seattle, Wash. AVAIL.NTIS

SAP: HC A14/MF A01

CIO: UNITED STATES; Wright-Patterson AFB, Ohio AFWAL

MAJS: / *AVIONICS/ *EXPERT SYSTEMS/ *FIGHTER AIRCRAFT/ *MAINTENANCE/ *ONBOARD EQUIPMENT/ *SYSTEMS INTEGRATION

MINS: / ARTIFICIAL INTELLIGENCE/ COST ANALYSIS/ DATA ACQUISITION/ LIFE CYCLE COSTS/ MILITARY AIRCRAFT/ SYSTEMS ANALYSIS/ SYSTEMS INTEGRATION/ WEAPON SYSTEMS

ABA: Author (GRA)

ABS: Maintenance of weapon systems is becoming an increasingly important consideration in weapon system development, because the cost of maintenance is a significant portion of the life cycle cost of the system. The objective of the Integrated Testing and Maintenance Technologies effort is to define requirements for an onboard test system for the avionic suite planned for tactical fighters in the 1990's. Problems with current onboard test systems were analyzed to determine where improvements could be made. In addition, the anticipated avionic architecture and mission of the 1990's were evaluated to determine the impact on maintenance capability. Requirements for the Integrated Testing and Maintenance System were developed and documented in a system specification. Identified improvements over current systems include better filtering of intermittent failure reports, better isolation of intermittent failures through the use of recorded data, more extensive use of system-level tests of mission operational data and a man-machine interface providing more information to the maintenance technician. In addition, artificial intelligence applications were evaluated to determine where they might be effectively applied to ITM. A design concept for a fault classification expert system was developed.

....

No.: M10 **Title:** Logistics Support

Operational Requirement:

Provide adequate spares provisioning from the beginning.

Rationale:

Spare parts provisioning is yet another illustration that the Shuttle Program was not prepared for an operational schedule. The conscious decision was made to postpone spare parts procurements in favor of budget items of perceived higher priority. The policy proved to be shortsighted and has led to the inefficiencies of cannibalization to support the flight rate.

From the Challenger Presidential Commission Report, "The logistics support for 51-L ground processing was inadequate, since it created a need to remove parts from other orbiters to continue 51-L operations. For 51-L, 45 out of approximately 300 required parts were cannibalized. These parts ranged from bolts to an OMS TVC actuator and a fuel cell. The significance to operations of cannibalization is that it creates (1) significantly increased efforts to accomplish the same work due to multiple installation and retest requirements, (2) schedule disruption due to added work and normally later part availability, and (3) orbiter damage potential due to increased physical activity in the vehicles. These efforts make cannibalization operationally unacceptable."

Sample Concept:

Accept the necessary up-front costs of adequate spares provisioning in order to reduce Life Cycle Costs with more efficient operations.

Technology Requirement:

None

Technology References:

NASA/RECON: 87A27619, 86A30550, 85N11996, 84N26962

87A27619# ISSUE 11 PAGE 1577 CATEGORY 14 RPT#: AIAA PAPER 87-0692 87/00/00 4 PAGES UNCLASSIFIED DOCUMENT COPYRIGHT

UTTL: Application of artificial intelligence (AI) concepts for employing logistics resources in the SDI environment

AUTH: A/BARRY, JOHN M.

PAA: A/(USAF, Rome Air Development Center, Los Angeles, CA)

CIO: UNITED STATES

IN: Space Logistics Symposium, 1st, Huntsville, AL, Mar. 24-26, 1987, Technical Papers (A87-27603 11-14). New York, American Institute of Aeronautics and Astronautics, 1987, p. 125-128.

MAJS: / *ARTIFICIAL INTELLIGENCE/ *LOGISTICS MANAGEMENT/ *SPACE WEAPONS/ *WEAPON SYSTEMS

MINS: / ALGORITHMS/ EXPERT SYSTEMS/ LIFE CYCLE COSTS/ ORBITAL SERVICING/ SPACE LOGISTICS/ SPACECRAFT MAINTENANCE

ABA: M.S.K.

ABS: AI applications for managing the logistics of SDI systems are described. The inadequacies of current logistics analysis techniques in the resence of the uncertainties, complexities and uniqueness of SDI systems are explored in depth, including the algorithms used, maintenance methods and predictions, resources scheduling, data acquisition and handling, and life cycle costing. Since many subsystems of SDI systems would be inaccessible to humans, embedded sensors could provided expert systems with data for identifying and isolating or predicting defects. The definition of sufficient goals and decision criteria is asserted to be a potential solution to the problem of scheduling repairs for failed components, estimating the costs of engineering decisions and interacting with users through a plain-language input.

....

86A30550 ISSUE 13 PAGE 1799 CATEGORY 5 86/04/00 4 PAGES UNCLASSIFIED DOCUMENT COPYRIGHT

UTTL: Logistics supportability considerations during conceptual and preliminary design

AUTH: A/SCHRAGE, D. P.; B/MEYER, S. A.

PAA: B/(Georgia Institute of Technology, Atlanta)

CIO: UNITED STATES; Vertiflite (ISSN 0042-4455), vol. 32, Mar.-Apr. 1986, p. 48-51.

MAJS: / *DESIGN ANALYSIS/ *HELICOPTER DESIGN/ *LIFE CYCLE COSTS/ *LIGHT AIRCRAFT/ * LOGISTICS

MINS: / DESIGN TO COST/ MILITARY HELICOPTERS/ STANDARDIZATION

ABA: I.F.

ABS: The concept formulation efforts of the 'light helicopter experimental' (LHX) program, which is based on improving combat effectiveness while reducing life cycle costs (LCCs), are described. The need to study logistic supportability considerations in the synthesis process of aircraft systems is examined. LCCs and logistic costs can be lowered by reducing: (1) the manpower required for support, (2) the cost of spares, (3) the reliance on test equipment, and (4) the cost of post development software support. Six systems for the LHX program aircraft that will lower LCCs are proposed. The economic and noneconomic benefits of the standarization of aircraft designs and the use of common components are studied. The development of a two-level maintenance system and the reduction of manpower are analyzed. The improvement of the reliability and maintainability of mission components and speed to insure self-deployability and sustainability of the aircraft is discussed. The elimination of automatic test equipment is examined.

....

85N11996# ISSUE 3 PAGE 309 CATEGORY 1 RPT#: AD-A145846 GAO/NSIAD-84-36 84/09/20 49 PAGES UNCLASSIFIED DOCUMENT

UTTL: Logistics support costs for the B-1B aircraft can be reduced

CORP: General Accounting Office, Washington, D. C.

CSS: (National Security and International Affairs Div.) AVAIL.NTIS

SAP: HC A03/MF A01

CIO: UNITED STATES

MAJS: / *AIRCRAFT/ *B-1 AIRCRAFT/ *COST REDUCTION/ *LOGISTICS/ *MAINTENANCE

MINS: / AVIONICS/ BOMBER AIRCRAFT/ COST EFFECTIVENESS/ COSTS/ GOVERNMENT PROCUREMENT/ PRODUCTION ENGINEERING/ PRODUCTION MANAGEMENT/ SCHEDULING/ SHOPS/ SPARE PARTS

ABA: GRA

ABS: While the Air Force's logistics support planning for the B-1 bomber has been extensive, the inadequacy of the logistics data developed during research and development of the B-1B's predecessor-the B-1A-and the concurrent development and production schedule necessitated by a congressional mandate that the aircraft be operational not later than 1987 have forced Air Force planners to make logistics support decisions before they had sufficient data to support them. This has increased the risk that operating and support costs will be more than they would have been had normal defense development procedures been employed before starting production. GAO has identified opportunities to reduce these costs which should be considered. They are: (1) combining the purchase of investment spares (components that can be repaired and reused) with the purchase of production components; (2) buying spares directly from the manufacturers instead of through the four B-1B contractors; (3) reducing the number of bases from four to three; and (4) centralizing all avionics maintenance repair at the B-1B airframe and engine depot repair facility and not establishing any repair shops at the planned B-1B bases.

....

84N26962# ISSUE 17 PAGE 2652 CATEGORY 32 82/00/00 5 PAGES UNCLASSIFIED DOCUMENT DCAF E070178

UTTL: The life cycle cost of integrated logistic support

AUTH: A/FLORIO, U. G.

CORP: Selenia Industrie Associate S.p.A., Rome (Italy). CSS: (Naval System Div.) AVAIL.NTIS

SAP: HC A03/MF A01 In its Rivista Tec. Selenia, Vol. 8, No. 1 p 1-5 (SEE N84-26961 17-32)

CIO: ITALY

MAJS: / *COST EFFECTIVENESS/ *LIFE CYCLE COSTS/ *LOGISTICS/ *MAINTENANCE

MINS: / FINANCIAL MANAGEMENT/ MARKOV PROCESSES/ SPARE PARTS

ABA: Author (ESA)

ABS: Scheduling of preventive maintenance within the general context of the life cycle cost of integrated logistic support is discussed. The principal categories of support cost are considered and a procedure of optimizing the total cost for the evaluation of a fundamental logistic parameters is developed using Markov models. The Markov approach allows the examination of the functional relationships between system reliability, maintenance policies and the costs of integrated logistic support. The life cycle cost of the logistic support is optimized, and the results permit a correct cost/efficiency scaling of he support.

....

No.: M11 **Title:** Operational Test Requirements

Operational Requirement:

Valid operational test requirements should be defined by the Design/Build Team (see M2) and integrated into VHMS (Vehicle Health Monitoring System) where possible.

Rationale:

Current and past LV programs, at both ETR and KSC, test and retest at the instigation of individual design, test, and technical management organizations (Contractor, NASA, and Aerospace). All of these practice CYA to extreme levels. Further, "once a test, always a test", with little or no effort made to remove test requirements which can no longer be justified. Many of these tests are the result of inadequate incorporation of operations experience in the design.

Even where the design includes self-test capability, old habits die hard. For example, on IUS, pre-deployment checkout utilizes a VHMS and verifies IUS readiness for deployment in approximately two minutes. Equivalent ground testing requires extensive manpower and GSE which manually sequences each test step, with serial manpower-intensive data analysis. Each time the IUS is moved, it is retested in this manner resulting in many additional weeks of test time.

Sample Concept:

Implement VHMS concept to fullest capability and not allow its capability to be duplicated at the test site with GSE and manpower in a make-work scenario.

Eliminate test/retest requirements imposed at the test site by the subjective confidence level of test engineers and/or technical management personnel. Unnecessary requirements are often imposed by personnel with no responsibilty for cost or schedule.

Technology Requirement:

VHMS

Technology References:

SGOE/T Study, Phase 1, Final Report, 4 May 1987.

No.: M12 **Title:** Quality Assurance

Operational Requirement:

A modern QA program that virtually eliminates the requirement for a large force of Quality inspectors with its inherent inefficiencies impacting processing times and costs.

Rationale:

Quality Assurance places emphasis on inspection. As a result of the Challenger loss and the Presidential Commission Report, program management has amplified this problem by increased manpower and efforts to inspect quality into the product. American industry, led by Japan's implementation of Deming's methods, is beginning to understand that inspection is not only costly, but also ineffective.

Sample Concept:

New systems design should place emphasis on computerized, self-check verification for electrical systems and require minimal inspection for mechanical and structural systems.

Management and workers must be be trained and led into a total quality program (a la Deming - see SGOE/T Final Phase 2, Volume 3, Part 2, SOCH Reference Information, Section 6.2). The Deming approach is not to automate quality verification, but instead to build quality into the product and promote quality workmanship thus eliminating the need for constant inspection. This would require a major change in culture as well as MIL-standards but needs to be done.

Technology Requirement:

Management reset and implementation.

Technology References:

DIALOG REFERENCE: 1934413

Ford Motor Company, Product Quality Office, Dr. Deming's Concepts, Dec. 1981.

Ron Cristofono Workshop Series, DEMING's FOURTEEN OBLIGATIONS OF MANAGEMENT

Scherkenbach, William W., THE DEMING ROUTE TO QUALITY AND PRODUCTIVITY

SGOE/T Study, Phase 2 Final Report, Volume 3, 4 May 1988

1934413 B87044011; Audit and the improvement of quality Pertusio, F. Elettron. Oggi (Italy) no.38 59-60 15 April 1987

CODEN: ELOGDA

ISSN: 0391-391

Treatment: GENERAL, REVIEW

Document_Type: JOURNAL PAPER

Languages: Italian; Gives some of the results of more than twenty years experience of 'audit' to determine quality throughout an organization. A block diagram is given showing the normal sequence of planning, improvement, control. The process is widely used in both the USA and in Japan and the term 'audit' covers a wide range, including such things as documentation, personnel behavior and the actual application of standards decided upon. The quality of the actual 'auditors' is vital and is discussed briefly and there is similar discussion of the quality system employed. The extreme importance of following a sequence of planning, improvement, control is emphasised.

Descriptors: AUDITING; QUALITY CONTROL

Identifiers: AUDIT; QUALITY; PLANNING; USA; JAPAN; DOCUMENTATION; PERSONNEL BEHAVIOR; STANDARDS; QUALITY SYSTEM

Class_Codes: B0170L

....

No.: M13 **Title:** Safety

Operations Requirement:

Special safety requirements, particularly for ordnance and propellant related items, must be reduced to a bare minimum and preferably eliminated where possible.

Rationale:

Hazardous operations and conditions in the vehicle preparation area greatly affect operations times and increase costs. During such times, technicians are prevented from doing useful work on the vehicle, and only one task can proceed at any one time. To minimize these delays, ordnance operations must be absolutely minimized and preferably eliminated from the processing flow.

Related KSC Schedule History:

1. The 160-hour schedule had 8 hours for ordnance installation at the Orbiter Processing Facility (OPF).

2. Currently 112 hours of processing time is spent in ordnance operations in the following areas:

   OPF..8 hours
   External Tank (E/T) Checkout Cell..............22 hours
   Vehicle Assembly Building (VAB)................44 hours
   PAD..36 hours
   (20 hours requires complete pad clear)

   Total 112 hours (Total on-line serial time 44 hours)

   This schedule is primarily taken from the as-run of 51-L, then modified to simulate a typical STS flow.

   The eight hours of scheduled ordnance work in the OPF is considered serial time since area clearing is required and restrictions are placed on other activities.

   The 66 hours in the VAB (including the E/T checkout cell is parallel work since it is primarily done while the orbiter is in the OPF. It does restrict some other work in the VAB.

   The 36 hours at the pad is the most detrimental to the schedule. At least 20 hours requires clearing the whole pad and it would be hard to calculate how many man-hours of other work are lost.

Sample Concept:

Management must assure that program requirements and RFP's reflect this requirement to minimize the impact of safety requirements through appropriate design, requirements and procedures. Also, the management of design, safety, quality, and operations personnel must assure that requirements and procedures are not redundant for CYA purposes only.

Technology Requirement:

See S4.

Technology References:
NASA/RECON: 85A13163

85A13163# ISSUE 3 PAGE 273 CATEGORY 14 RPT#: IAF PAPER 84-266 84/10/00 15 PAGES UNCLASSIFIED DOCUMENT

UTTL: Space Shuttle ground processing - The safety challenge

AUTH: A/BREM, H. L., JR. PAA: A/(Lockheed Space Operations Co., Titusville, FL)

CIO: UNITED STATES; International Astronautical Federation, International Astronautical Congress, 35th, Lausanne, Switzerland, Oct. 7-13, 1984. 15 p.

MAJS: / *GROUND HANDLING/ *SAFETY FACTORS/ *SPACE TRANSPORTATION SYSTEM

MINS: / GROUND CREWS/ GROUND SUPPORT EQUIPMENT/ HAZARDS/ LOGISTICS/ TECHNOLOGY ASSESSMENT

ABA: Author

ABS: This paper discusses the safety aspects of the ground processing of the 'Space Shuttle': It describes in general terms the flow of the processing from orbiter landing to the succeeding launch. It notes in some detail the known hazards associated with the Space Transportation System and the impact these hazards have on a single serial processing flow e.g., the requirements clearing work areas of nonessential personnel to accommodate possible exposures to toxic vapors and liquids or the hazards associated with solid rocket motor segments. It then describes how these hazards and limitations have significantly greater impact when considered in light of the multiple flow processing required to meet increasing launch rates.

....

No.: M14 **Title:** Security

Operational Requirement:

Security requirements which impact costs (most do) should be minimal and realistic.

Rationale:

Operational costs for past and current programs have been significantly impacted by security requirements. Cost impact data was not available or considered. This cost impact includes security control and accountability of paperwork; controlled access areas; screenrooms; TEMPEST equipment; separate software; etc.

Sample Concept:

Impact (of security requirements) should be defined by the Design/Build team and fed back to Program management for reevaluation of security requirements on Design-to-Cost. In other words, don't run open loop on the cost implication of security requirements.

Technology Requirement:

None.

Technology References:

None.

No: M15 **Title:** Connectivity Architectures

Operations Requirement:

Conform to computer interface standards to allow complete connectivity (both text and graphics) between organizations including Design, Manufacturing, Logistics, Procurement, Operations, etc.

Rationale:

Current methods of information flow is inadequate, not time synchronized (much less in real time), and error prone.

Connectivity architecture is rapidly becoming available which allows ready interchange of data among different computer operating systems and databases.

Significant cost reduction in LCC can be made by contractual requirement to utilize industry / government standards.

Technology Requirement:

DoD Internet Architecture.
MIL-STD-1840A.

Technology References:

Final Report SGOE/T Study, Phase 2, Volume 3, Part 2 (ULCE Section 2.1).

No.: A1 **Title:** BIT/BITE (On-Board Checkout)

Operations Requirement:

Current configurations require extensive use of GSE to support vehicle checkout. Future systems should incorporate onboard checkout and minimize (preferably eliminate) GSE.

Vehicles should have sufficient self-test capability to verify flight readiness or isolate problem to LRU.

Rationale:

Current configurations require complex GSE hookups to support system test and operational verification. The configuration verification, required for test hookup and calibration, defeats efficient operations.

To accomplish order-of-magnitude cost reduction, we must achieve 160-Hr or better turnaround time for recoverable stages. (160-Hrs was the original STS Turnaround goal whose actuals have grown an order-of-magnitude). In addition to turnaround times exceeding 1500 hours, aging recoverable vehicles will impose requirements for structural inspections which will require extensive time periods offline. ELV's must have comparable processing times.

Sample Concept:

After a firm set of test requirements has been defined early in the design phase, the associated hardware/software required to support on-board testing must be incorporated in each subsystem. It is important to maintain subsystem self-test autonomy.

BIT identifies and records anomalies during flight. After landing, BIT/BITE isolates problem to LRU level. After replacement, BIT/BITE retests and verifies flight readiness. Ideally, recoverable vehicles would include sensors for complete structural integrity to avoid extensive downtimes.

Technology Requirement:

Further development of Vehicle Health Monitoring System (VHMS) with BIT/BITE to meet specific requirements. Development of structural sensors including corrosion.

Technology References:

NASA/RECON:

87N10079, 87A33872, 87A32118, 86N20489, 86A40591, 86A32796, 86A31260, 86A23765, 85X77042, 85X70467, 85N34596, 85N22528, 85N20697, 85N16900, 85N16898, 85N16897, 85N16753, 85N11594, 85A45975, 85A45398, 85A45082, 85A28633, 85A26804, 85A24795, 85A13194, 84X76865, 84X74856, 84X71619, 84N34500, 84N26573, 84N14754, 84A46661, 83A49578, 83A45473

87N10079# ISSUE 1 PAGE 13 CATEGORY 6 86/02/00 17 PAGES UNCLASSIFIED DOCUMENT DCAF E070125

UTTL: Experience with the Onboard Checkout And Monitoring System (OCAMS) of a military aircraft resulting improvements and the consequence for future design

AUTH: A/NUMBERGER, K.; B/PROBST, K.

CORP: Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany).

SAP: Avail: NTIS HC A25/MF A01; DFVLR, Cologne, West Germany, DM 150 In DFVLR Proceedings of the 13th Symposium on Aircraft Integrated Data Systems p 75-92 (SEE N87-10075 01-06) CIO GERMANY, FEDERAL REPUBLIC OF

MAJS: / *AIR DATA SYSTEMS/ *AVIONICS/ *CHECKOUT/ *ENGINE MONITORING INSTRUMENTS/ * MILITARY AIRCRAFT

MINS: / AIRCRAFT DESIGN/ COMPUTER SYSTEMS DESIGN/ ONBOARD DATA PROCESSING

ABA: ESA

ABS: The Onboard Checkout and Monitoring System was designed to provide for test and diagnosis of defects to avionic and certain nonavionic equipments. Experience showed what could be improved. Engine and structure monitoring must be improved, still more information would be useful to store, and it was realized that the high sensitivity of the BIT detected also very transient faults. In order to cover these problems, the data acquisition unit of the crash recorder system will be extended with an engine and structural life monitoring system. Using the opportunity of introducing a data communication bus into the avionic system, facilities for data collection, correlation, and event monitoring will be initiated. Based on this the principal structure of the monitoring and test systems of future aircraft can be designed.

....

87A33872 ISSUE 14 PAGE 2108 CATEGORY 6 87/02/00 4 PAGES UNCLASSIFIED DOCUMENT

UTTL: Designing to MIL-STD-2165 - Testability — of V-22 avionics

AUTH: A/CROKE, DAN; B/BRAMEYER, JAN; C/THOM, JET K. PAA: B/(National Aircraft Standards Committee, Washington, DC); C/(Harris Corp., Syosset, NY)

CIO: UNITED STATES; IEEE Aerospace and Electronic Systems Magazine (ISSN 0885-8985), vol. 2, Feb. 1987, p. 23-26.

MAJS: /*AIRCRAFT INSTRUMENTS/ *AVIONICS/ *ELECTRONIC EQUIPMENT TESTS/ *IN-FLIGHT MONITORING

MINS: /AUTOMATIC TEST EQUIPMENT/ ONBOARD DATA PROCESSING/ SELF TESTS

ABA: I.F.

ABS: The incorporation of testability requirements into the V-22 avionics hardware is examined. MIL-STD-2165, which consists of program monitoring and control, design and analysis, and test and evaluation tasks, is a uniform approach for testability program planning. Two approaches, bottom-up and top-down, to implementing MIL-STD-2165 are analyzed. Previous avionics hardware testability requirements are compared with those applied to the V-22 avionics; the differences between the requirements are discussed. The central integrated checkout which provides effective organizational level fault detection/isolation coverage is described.

....

87A32118 ISSUE 13 PAGE 1916 CATEGORY 8 87/02/00 7 PAGES UNCLASSIFIED DOCUMENT

UTTL: The Boeing 7J7 advanced technology airplane

AUTH: A/SUTCLIFFE, PETER L. PAA: A/(Boeing Commercial Airplane Co., Seattle, WA)

CIO: UNITED STATES; IEEE Control Systems Magazine (ISSN 0272-1708), vol. 7, Feb. 1987, p. 9-15.

MAJS: / *AIRCRAFT DESIGN/ *AIRCRAFT MAINTENANCE/ *AVIONICS/ *BOEING AIRCRAFT/ *FLIGHT CONTROL/ *PROPULSION SYSTEM CONFIGURATIONS

MINS: /AIRFRAMES/ AUTOMATIC PILOTS/ DISPLAY DEVICES/ MTBF/ PAYLOADS/ TECHNOLOGY ASSESSMENT

ABA: M.S.K.

ABS: Advanced design features being studied for the 7J7 transport aircraft are described, and the impacts the new technologies will have on operational costs are examined. The aircraft, intended to carry 150 passengers, will feature ultrahigh-bypass engines, advanced digital avionics and flat panel displays, composite and Al-Li structural materials, and, possibly, propane propulsion. A 10 percent reduction in operating cost is expected compared to the A 320 aircraft to be operational in 1989. Some of the savings will be realized by CAD/CAM techniques that define airfoils with natural laminar flow. Primary structures will be Al-Li while secondary structures are projected to be graphite-epoxy thermoset resins. The 7J7 will also carry an on-board maintenance computer for identifying component failures and their replacement procedures, thus reducing maintenance overhead.

....

86N20489# ISSUE 11 PAGE 1735 CATEGORY 18 RPT#: NLR-TR-84133-L ESA-CR(P)-2100 AD-B101426L CNT#: ESA-5262/82 84/05/18 267 PAGES UNCLASSIFIED DOCUMENT DCAF E003091

UTTL: Testing of spacecraft attitude and orbit control systems

TLSP: Final Report

AUTH: A/PRINS, J. J. M.

CORP: National Aerospace Lab., Amsterdam (Netherlands). CSS: (Spaceflight Div.) AVAIL.NTIS

SAP: HC A12/MF A01

CIO: NETHERLANDS; Paris ESA

MAJS: / *PERFORMANCE TESTS/ *PRODUCT DEVELOPMENT/ *QUALITY CONTROL/ *SATELLITE ATTITUDE CONTROL/ *SATELLITE ORBITS

MINS: /COMPUTER SYSTEMS PERFORMANCE/ DYNAMIC TESTS/ ONBOARD DATA PROCESSING/ STATIC TESTS/ TEST FACILITIES

ABA: Author (ESA)

ABS: The testing of spacecraft Attitude and Orbit Control Subsystems (AOCS) from the early design up to in-flight is described. Three generic AOCS test classes, model philosophy, standardization, subsystem static test methods, subsystem dynamic test methods, generic test equipment, and test facilities are covered. It is suggested that test scheduling should aim to find problems and errors as early as possible. System level tests should be delayed in favor of detailed testing of the AOCS (unit level) and in particular subsystem level testing. Onboard AOCS software poses testing problems, especially when RAM located. There is a shift from airbearing-type dynamic tests to servo-table-type dynamic tests, mainly due to increasing spacecraft size structural flexibility, and multibody dynamics concepts.

....

86A40591# ISSUE 19 PAGE 2859 CATEGORY 66 RPT#: AIAA PAPER 86-1183 86/00/00 5 PAGES UNCLASSIFIED DOCUMENT COPYRIGHT

UTTL: Anomaly detection and resolution system

AUTH: A/FERNEYHOUGH, D. G., JR.

PAA: A/(IBM Corp., Federal Systems Div., Gaithersburg, MD)

CIO: UNITED STATES

IN: Space Systems Technology Conference, San Diego, CA, June 9-12, 1986, Technical Papers (A86-40576 19-12). New York, American Institute of Aeronautics and Astronautics, 1986, p. 106-110.

MAJS: / *EXPERT SYSTEMS/ *SPACECRAFT DESIGN

MINS: / COST REDUCTION/ LIFE CYCLE COSTS/ MILITARY TECHNOLOGY/ TELEMETRY

ABA: Author

ABS: The traditional approaches to anomaly detection and resolution for modern weapons systems, spacecraft, and complex ground installations are inadequate to meet the requirements incumbent upon future systems. Expert system technology appears to offer a solution, but new types of expert systems will be required. IBM has developed and implemented a concept for such a system. This paper describes that concept, its potential applications, and some of the implications that this general approach has for the design of future spacecraft.

....

86A32796 ISSUE 14 PAGE 2054 CATEGORY 38 86/04/00 6 PAGES UNCLASSIFIED DOCUMENT

UTTL: The effect of incomplete and deleterious periodic maintenance on fault-tolerant computer systems

AUTH: A/YAK, Y. W.; B/DILLON, T. S.; C/FORWARD, K. E.

PAA: A/(Philips Communications Systems, Ltd., Clayton, Australia); B/(La Trobe University, Bundoora, Australia); C/(Melbourne, University, Parkville, Australia)

CIO: AUSTRALIA; IEEE Transactions on Reliability (ISSN 0018-9529), vol. R-35, April 1986, p. 85-90.

MAJS: /*AVAILABILITY/ *COMPUTER SYSTEMS PERFORMANCE/ *FAULT TOLERANCE/ *MAINTENANCE / *RELIABILITY ANALYSIS/ *SYSTEM FAILURES

MINS: /MTBF/ PERIODIC FUNCTIONS/ PROBABILITY THEORY/ REDUNDANT COMPONENTS/ SPARE PARTS

ABA: C.D.

ABS: The mean time to first failure (MTFF) of a system which is maintained perfectly on failure and is also subject to preventive maintenance (PM) is derived. The MTFF is obtained for three classes of PM: (1) perfect periodic PM; (2) incomplete PM (system renewed with a stated probability, otherwise it remains unchanged); and (3) deleterious PM (system renewed with a stated probability, otherwise it fails). The third case is emphasized, studying the effect of varying the PM-induced failure probability on MTFF, the effect of increasing the number of spares which can be switched in automatically to replace failed units, and the effect of varying the ratio of repair time of PM-induced failure to repair time of 'natural' failure.

....

86A31260 ISSUE 13 PAGE 1912 CATEGORY 63 84/00/00 688 PAGES UNCLASSIFIED DOCUMENT

UTTL: Conference on Decision and Control, 23rd, Las Vegas, NV, December 12-14, 1984, Proceedings. Volume 1

CIO: UNITED STATES; Conference sponsored by IEEE. New York, Institute of Electrical and Electronics Engineers, 1984, 688 p. No individual items are abstracted in this volume.

MAJS: /*CONFERENCES/ *CONTROL SYSTEMS DESIGN/ *CONTROL THEORY/ *DECISION THEORY

MINS: /ADAPTIVE CONTROL/ COMPUTER TECHNIQUES/ CONTROL STABILITY/ DISTRIBUTED PARAMETER SYSTEMS/ ELECTRIC POWER SUPPLIES/ ESTIMATING/ FAULT TOLERANCE/ LARGE SPACE STRUCTURES/ NONDESTRUCTIVE TESTS/ NONLINEAR SYSTEMS/ OPTIMAL CONTROL/ PROCESS CONTROL (INDUSTRY)/ PRODUCTION PLANNING/ QUEUEING THEORY/ SIGNAL PROCESSING/ SPACECRAFT CONTROL/ SYSTEM FAILURES/ SYSTEM IDENTIFICATION/ VOLTAGE REGULATORS

ABA: C.D.

ABS: Various papers on decision and control in engineering are presented. The general topics addressed include: estimation and filtering, stochastic adaptive control nonlinear systems, model order reduction, new approaches to stability problems of electric power systems, reliable/robust control and some applications to large-space structures, production planning and control of manufacturing systems, control systems governed by nonlinear partial differential equations, generalized state-space systems, and frequency-domain design of multivariable control systems. Also discussed are: identification, implementation issues and applications of adaptive control, analysis and synthesis of nonlinear input-output responses, signal processing, voltage VAR modeling and control for power systems, optimal control and filtering algorithms, analysis of queueing networks and related systems, control of distributed parameter systems, computer-aided technology, control of linear systems, and failure detection and fault-tolerant systems.

....

86A23765 ISSUE 9 PAGE 1154 CATEGORY 6 85/00/00 5 PAGES In CZECH UNCLASSIFIED DOCUMENT

UTTL: The possibility of using the on-board computer for in-flight diagnostics

AUTH: A/KNEZOVIC, M.

CIO: CZECHOSLOVAKIA Zpravodaj VZLU (ISSN 0044-5355), no. 4, 1985, p. 253-257. In Czech.

MAJS: /*AIRBORNE/SPACEBORNE COMPUTERS/ *AIRCRAFT PARTS/ *AIRCRAFT PERFORMANCE/ * IN-FLIGHT MONITORING/ *TECHNOLOGY UTILIZATION

MINS: / ONBOARD DATA PROCESSING/ REAL TIME OPERATION

ABA: V.L.

ABS: The possibility of using the on-board digital computer for monitoring the condition of the aircraft and its components during the flight is examined. It is suggested that, in addition to routine flight data processing, such a system can monitor in real time the parameters characterizing the technical conditions of the aircraft and its systems, analyze this information, and issue a timely warning of the impending danger.

....

85X77042# CATEGORY 85 RPT#: AD-B092191L FTD-ID(RS)T-0815-84 85/05/07 8 PAGES UNCLASSIFIED DOCUMENT US GOV AGENCIES COPYRIGHT

UTTL: New horizons in technology

AUTH: A/KOVALEV, V.

CORP: Air Force Systems Command, Wright-Patterson AFB, Ohio.

CSS: (Foreign Technology Div.)

CIO: U.S.S.R. Transl. into ENGLISH from Ogonek (USSR), no. 6, 4 Feb. 1984 p 30-31

MAJS: / *ARTIFICIAL INTELLIGENCE/ *LOGISTICS/ *MAN MACHINE SYSTEMS/ *ROBOTS

MINS: / TECHNOLOGY ASSESSMENT

....

85X70467# CATEGORY 1 RPT#: AD-B083714L REPT-2838-01-1-3233 USAAVRADCOM-TR-83-D-28 CNT#: DAAK51-82-C-0037 DA PROJ. 1L1-62209-AH-76 84/06/00 82 PAGES UNCLASSIFIED DOCUMENT US GOV AGENCIES AND CONTRACTORS

UTTL: Application of advanced testability design and fault-isolation analysis

TLSP: Final Report, Sep. 1982 - Aug. 1983

AUTH: A/CRAMER, M. L.; B/BARTO, K. B.; C/CURTIS, D. C.; D/SIMPSON, W. R.

CORP: Arinc Research Corp., Annapolis, Md.

CIO: UNITED STATES

MAJS: / *AIRCRAFT MAINTENANCE/ *COMPUTER TECHNIQUES/ *COST EFFECTIVENESS/ *DIAGNOSIS / *FAULT TOLERANCE/ *FAULT TREES/ *LIFE CYCLE COSTS/ *LOGIC/ *PERFORMANCE TESTS / *STABILITY AUGMENTATION/ *SYSTEMS ANALYSIS

MINS: / DESIGN ANALYSIS/ HELICOPTERS/ ISOLATION/ MILITARY AIRCRAFT/ QUALITATIVE ANALYSIS/ STABILITY TESTS/ SYSTEMS ENGINEERING/ UTILIZATION

....

85N34596 ISSUE 23 PAGE 3967 CATEGORY 63 RPT#: SFENA-DPS/C/S3/84252A CNT#: DRET-83-1423 84/12/00 80 PAGES In FRENCH UNCLASSIFIED DOCUMENT DCAF E003393

UTTL: Implications of artificial intelligence on the design of future onboard systems

TLSP: Final Report

AUTH: A/BILLOIR, T.

CORP: Societe Francaise d'Instruments de Mesure, Massy (France).

SAP: Avail: Issuing Activity

CIO: FRANCE

MAJS: / *AIRCRAFT MAINTENANCE/ *ARTIFICIAL INTELLIGENCE/ *EXPERT SYSTEMS/ *ONBOARD DATA PROCESSING

MINS: / AIRBORNE/SPACEBORNE COMPUTERS/ AIRCRAFT DESIGN/ RESEARCH AND DEVELOPMENT / TRENDS

ABA: Author (ESA)

ABS: The applicability of artificial intelligence to aircraft or spacecraft design is discussed. A progress report on the research and development of the AMES airborne maintenance expert system is included.

....

85N22528 #ISSUE 13 PAGE 1998 CATEGORY 25 84/10/00 15 PAGES UNCLASSIFIED DOCUMENT

UTTL: Status of boron combustion research

AUTH: A/FAETH, G. M.

CORP: Pennsylvania State Univ., University Park. CSS: (Dept. of Mechanical Engineering.)

AVAIL.NTIS

SAP: HC A21/MF A01 In APL 21st JANNAF Combust. Meeting, Vol. 1 p 15-29 (SEE N85-22526 13-20)

CIO: UNITED STATES

MAJS: / *AIR BREATHING ENGINES/ *BORON/ *METAL COMBUSTION/ *PROPELLANT COMBUSTION/ * PROPELLANT GRAINS

MINS: / ATOMIZING/ COATINGS/ ENERGY CONVERSION/ IGNITION/ OXIDES/ SLURRIES/ TRANSPORT PROPERTIES/ TURBULENT MIXING

ABA: A.R.H.

ABS: The potential performance of boron fuels as well as problems encountered during combustion of liquid and solid propellants containing boron are discussed. Current understanding of combustion of boron particles and slurries, and expansion and plume processes of combustion products of boron are described. Research problems suggested include: atomization and secondary breakup of slurries to promote boron particle dispersion and rapid combustion; particle surface properties and treatments, to better understand flammability limits and promote ignition; heterogeneous and homogeneous B-O-H chemistry, to provide more rational understanding of boron combustion and energy conversion; oxide coating structure, to resolve controversy concerning the mechanism whereby this layer inhibits boron particle ignition; transport properties of particle agglomerates, to determine the extent of transport enhancement by percolation through agglomerates; coalescence and injection of boron particles from solid propellant grains, to help resolve the problems of high particle loadings in boron-containing solid propellants; and turbulent mixing and reaction of boron-particle-laden flows to establish more rational combustion chamber design methods.

....

85N20697# ISSUE 11 PAGE 1701 CATEGORY 61 RPT#: AD-A149345 CNT#: DAAK01-83-R-A267 84/09/30 128 PAGES UNCLASSIFIED DOCUMENT

UTTL: BIT/BITE Tradeoff Analysis Model

TLSP: Final Report

AUTH: A/SCHWEMMER, E.; B/BAKER, M.; C/BAILEY, G.

CORP: Sperry Systems Management, Huntsville, Ala. AVAIL.NTIS

SAP: HC A07/MF A01

CIO: UNITED STATES

MAJS: / *COMPUTERIZED SIMULATION/ *LIFE CYCLE COSTS/ *PERFORMANCE TESTS/ *TRADEOFFS / *WEAPON SYSTEMS

MINS: / COST EFFECTIVENESS/ MAINTENANCE/ MODELS/ SYSTEMS ANALYSIS

ABA: GRA

ABS: This document is a discussion of the fundamental methodologies employed in the BIT/BITE TRADEOFF ANALYSIS MODEL. The model is designed to facilitate rapid evaluations of cost interactions and sensitivity to testability policies and associated test equipment. The primary objective is to develop a computer model that will assist the user in the selection of a cost-effective test policy for the life cycle of a proposed weapon system. The model is designed so that different approaches to sub-analysis can be selected on a data available basis to conduct tradeoff analyses between/among Built-In-Test, Built-In-Test Equipment, Automatic, Semi-Automatic, Manual Test Equipment and Sample Inspection Equipment that will test to levels necessary to support depot, intermediate rear, intermediate forward, and operational areas. The model is designed to highlight test methodology cost impact and compute the total life cycle costs of the system.

....

85N16900*# ISSUE 8 PAGE 1092 CATEGORY 16 85/01/00 5 PAGES UNCLASSIFIED DOCUMENT

UTTL: Automation of checkout for the shuttle operations era

AUTH: A/ANDERSON, J. A.; B/HENDRICKSON, K. O.

CORP: National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla. AVAIL.NTIS

SAP: HC A25/MF A01 In NASA. Johnson Space Center Space Shuttle Tech. Conf., Pt. 1 p 97-101 (SEE N85-16889 08-12)

CIO: UNITED STATES

MAJS: / *AUTOMATION/ *AVIONICS/ *COMPUTER TECHNIQUES/ *ONBOARD DATA PROCESSING/ * SPACE SHUTTLES/ *SPACE VEHICLE CHECKOUT PROGRAM

MINS: / AIRBORNE/SPACEBORNE COMPUTERS/ COMPUTER SYSTEMS PROGRAMS/ GROUND SUPPORT SYSTEMS/ NUMERICAL CONTROL/ PRELAUNCH TESTS

ABA: E.A.K.

ABS: The Space Shuttle checkout is different from its Apollo predecessor. The complexity of the hardware, the shortened turnaround time, and the software that performs ground checkout are outlined. Generating new techniques and standards for software development and the management structure to control it are implemented. The utilization of computer systems for vehicle testing is high lighted.

....

85N16898*# ISSUE 8 PAGE 1092 CATEGORY 16 85/01/00 6 PAGES UNCLASSIFIED DOCUMENT

UTTL: Integration of ground and on-board system for terminal count

AUTH: A/ABNER, C. A.; B/TOWNSEND, D. H.

CORP: National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla. AVAIL.NTIS

SAP: HC A25/MF A01 in NASA. Johnson Space Center Space Shuttle Tech. Conf., Pt. 1 p 81-86 (SEE N85-16889 08-12)

CIO: UNITED STATES

MAJS: / *COMPUTER SYSTEMS DESIGN/ *GROUND SUPPORT SYSTEMS/ *ONBOARD DATA PROCESSING / *SPACE SHUTTLE ORBITERS/ *TERMINAL GUIDANCE

MINS: / AIRBORNE/SPACEBORNE COMPUTERS ONBOARD EQUIPMENT/ SPACE TRANSPORTATION SYSTEM FLIGHTS/ SPACECRAFT LAUNCHING

ABA: E.A.K.

ABS: The development of an integrated ground and onboard system for Space Shuttle terminal count management is discussed. The criteria considered in designing this system are outlined. Examples of problems encountered in the process of maturing the design are presented.

....

85N16897*# ISSUE 8 PAGE 1091 CATEGORY 54 85/01/00 5 PAGES UNCLASSIFIED DOCUMENT

UTTL: Ground man-machine interfaces for orbiter checkout

AUTH: A/BLACKMON, F. H.

CORP: International Business Machines Corp., Cape Canaveral, Fla. AVAIL.NTIS

SAP: HC A25/MF A01 In NASA. Johnson Space Center Space Shuttle Tech. Conf., Pt. 1 p 76-80 (SEE N85-16889 08-12)

CIO: UNITED STATES

MAJS: / *APOLLO SPACECRAFT/ *MAN MACHINE SYSTEMS/ *REUSABLE SPACECRAFT/ *SPACE SHUTTLE ORBITERS/ *SPACE TRANSPORTATION SYSTEM FLIGHTS

MINS: / COMPARISON/ FLIGHT TESTS/ GROUND SUPPORT SYSTEMS/ LAUNCH VEHICLES/ ONBOARD DATA PROCESSING/ SPACE VEHICLE CHECKOUT PROGRAM

ABA: E.A.K.

ABS: The challenge of the concept of a reusable, cargo carrying space vehicle, and how those challenges were met for the Space Shuttle are discussed. The complexity of the vehicle, the ground support system, the onboard computer system, ramifications of a reusable vehicle, and the turn around objectives for Shuttle flights are outlined. The Apollo and the space transportation system (STS) are compared.

....

85N16753# ISSUE 8 PAGE 1066 CATEGORY 60 84/10/00 6 PAGES UNCLASSIFIED DOCUMENT

UTTL: Hardware/software co-design for maintainable systems

AUTH: A/FRANK, G. A.

CORP: Research Triangle Inst., Research Triangle Park, N.C. AVAIL.NTIS

SAP: HC A13/MF A01 In AGARD Design for Tactical Avionics Maintainability 6 p (SEE N85-16731 08-01)

CIO: UNITED STATES

MAJS: /*ARCHITECTURE (COMPUTERS)/ *COMPUTER AIDED DESIGN/ *COMPUTER SYSTEMS PROGRAMS/*COMPUTERS/ *HARDWARE/ *INFORMATION THEORY/ *INTERFACES

MINS: / COMPUTER PROGRAMS/ DATA PROCESSING EQUIPMENT/ GRAPHS (CHARTS)/ LOGIC DESIGN/ MACHINE TRANSLATION/ MAINTENANCE/ MILITARY TECHNOLOGY/ PETRI NETS/ PRODUCT DEVELOPMENT

ABA: E.A.K.

ABS: The co-design of software/hardware which can improve the maintainability of military systems is discussed. The following methods are outlined: (1) support of the design verification process to make it more complete and less costly; (2) reduction of the cost of a system modification by providing accurate, machine readable documentation of the system design; and (3) support of the detection, isolation, and correction of faults on both software and hardware. Development of techniques for software/hardware co-design of high performance signal processors is examined. The methodology is based on the representation of both software and hardware as directed graphs. The system of computer aided design (CAD) tool that support this methodology is the architecture design and assessment system (ADA). The system has two types of components: graph processing

modules, which can be applied to any graph, and interfaces to specialized tools, which operate on specific kinds of graphs. The graph processing tools include an interactive graphics editor, a library manager, a Petri net analysis tool, and a Petri net simulator. The interfaces include an HDL interface, and Ada interface, and a reliability tool interface.

....

85N11594# ISSUE 2 PAGE 244 CATEGORY 63 RPT#: AD-P003914 84/06/00 22 PAGES UNCLASSIFIED DOCUMENT

UTTL: Artificial intelligence applications to maintenance

AUTH: A/COPPOLA, A.

CORP: Rome Air Development Center, Griffiss AFB, N.Y. AVAIL.NTIS

SAP: HC A22/MF A01; In Denver Research Inst. Artificial Intelligence in Maintenance p 23-4 (SEE N85-11592 02-6)

CO: UNITED STATES

MAJS: / *ARTIFICIAL INTELLIGENCE/ *AUTOMATIC TEST EQUIPMENT/ *COST ANALYSIS/ * MAINTENANCE/ *RESEARCH/ *TECHNOLOGY ASSESSMENT/ *WEAPON SYSTEMS

MINS: / LABOR/ MANAGEMENT METHODS/ PROJECT MANAGEMENT/ QUALITY CONTROL

ABA: GRA

ABS: The maintenance of modern military systems employs a variety of automation. Built-In-Test provides on-line fault detection and some isolation, Automatic Test Equipment is indispensable at intermediate and depot repair stations, and automated maintenance aids and trainers abound. These developments were designed to speed maintenance and to compensate for declining skill levels in the maintenance force. They are currently far from satisfactory. Modern maintenance is characterized by excessive false alarms and unnecessary removals at all levels of maintenance. The results of these deficiencies are long maintenance times, resources wasted in unnecessary for inefficient maintenance actions, and systems out of action which need not be. Correcting these problems would therefore provide both a economic advantage and a force multiplier. To create quantum improvements in maintenance will require the application of radical changes to the technology. One possibility is the application of Artificial Intelligence (AI) techniques to maintenance. AI is beginning to see application to practical problems in many disciplines, and hence is potentially capable of relatively rapid implementation into military systems. At present, DoD efforts in applying AI to maintenance are small and exploratory. The task of the Artificial Intelligence Applications committee was to examine the opportunities for applying AI to maintenance, assess the costs, risk, and development time required, and provide recommendations to the DoD for action.

....

85A45975*# ISSUE 22 PAGE 3227 CATEGORY 6 RPT#: AIAA PAPER 85-1908 85/08/00 9 PAGES UNCLASSIFIED DOCUMENT

UTTL: Design of an expert-system flight status monitor

AUTH: A/REGENIE, V. A.; B/DUKE, E. L. PAA: B/(NASA, Flight Research Center, Edwards, CA)

CORP: National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.

CIO: UNITED STATES - AIAA, Guidance, Navigation and Control Conference, Snowmass, CO, Aug. 19-21, 1985. 9 p.

MAJS: / *AVIONICS/ *CONTROL SYSTEMS DESIGN/ *EXPERT SYSTEMS/ *FLIGHT MANAGEMENT SYSTEMS

MINS: / AIRCRAFT DESIGN/ AIRCRAFT PARTS/ AUTOMATIC FLIGHT CONTROL/ COMPLEX SYSTEMS/ F-16 AIRCRAFT/ RESEARCH AND DEVELOPMENT

ABA: I.F.

ABS: The present technology used to monitor systems in flight tests is not advanced enough for the modern avionics in high performance aircraft. Research is being conducted at NASA's Dryden Flight Research Facility to design an expert system to monitor test flights. The expert system is to automatically detect any problems in the flight control system (FCS), interpret the problem from the information contained in its knowledge base, inform

the systems engineer, and recommend solutions. The data is to be downlinked from the aircraft to the control room. The expert system will lessen the responsibilities of the engineers by providing them with fast, expert advice. Time is the most critical factor in flight testing and the expert system will be able to quickly recognize discrepancies and provide corrections. A demonstration of the expert system, not operating in real time, has already been tested.

....

85A45398* ISSUE 22 PAGE 3233 CATEGORY 12 84/00/00 4 PAGES UNCLASSIFIED DOCUMENT

UTTL: Space Station automation and autonomy

AUTH: A/CARLISLE, R. F.

PAA: A/(NASA, Washington, DC)

CORP: National Aeronautics and Space Administration, Washington, D.C.

CIO: UNITED STATES

IN: IECEC '84: Advanced energy systems - Their role in our future; Proceedings of the Nineteenth Intersociety Energy Conversion Engineering Conference, San Francisco, CA, August 19-24, 1984. Volume 1 (A85-45351 22-44). La Grange Park, IL, American Nuclear Society, 1984, p. 364-367.

MAJS: / *ONBOARD DATA PROCESSING/ *ONBOARD EQUIPMENT/ *SPACE STATION POWER SUPPLIES / *SPACE STATIONS/ *SPACECRAFT POWER SUPPLIES

MINS: / AIRBORNE/SPACEBORNE COMPUTERS/ ARTIFICIAL INTELLIGENCE/ MAN MACHINE SYSTEMS/ POWER CONDITIONING/ REDUNDANT COMPONENTS

ABA: O.C.

ABS: As the complexity of NASA's planned Space Station design grows, decision-making must be transferred from the crew to an onboard computer system devised for maximum man/machine interactions productivity. The Space Station's electrical power subsystem is presently taken as an exemplary case of design evolution from the manual, through the automated, to the fully autonomous control regimes.

....

85A45082* ISSUE 21 PAGE 3058 CATEGORY 14 84/00/00 7 PAGES UNCLASSIFIED DOCUMENT

UTTL: Knowledge-based fault monitoring and diagnosis in Space Shuttle propellant loading

AUTH: A/SCARL, E. A.; B/JAMIESON, J.; C/DELAINE, C. PAA: A/(Mitre Corp., Bedford, MA); C/(NASA, Kennedy Space Center, Cocoa Beach, FL)

CORP: Mitre Corp., Bedford, Mass.; National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.

CIO: UNITED STATES; IN: NAECON 1984; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 21-25, 1984. Volume 2 (A85-44976 21-01). New York, IEEE, 1984, p. 768-774. NASA-sponsored research.

MAJS: / *EXPERT SYSTEMS/ *GROUND HANDLING/ *PROPELLANT TRANSFER/ *SPACE SHUTTLE ORBITERS/ *SYSTEM FAILURES

MINS: /DATA BASES/ DIAGNOSIS/ FAILURE ANALYSIS

ABA: C.D.

ABS: The LOX Expert System (LES), now being developed as a tool for the constraint-based monitoring and analysis of propellant loading at the Kennedy Space Center (KSC), is discussed. The loading of LOX at the KSC and its control and monitoring by the Launch Processing System are summarized, and the relevant problem for LES is presented. The LES database is briefly described, and the interaction of LES with KNOBS, a constraint- and frame-oriented knowledge-based system developed as a demonstration system in aid of tactical air mission planning, is the context of launch processing is discussed in detail. The design and fault isolation techniques of LES are also discussed.

....

85A28633 ISSUE 12 PAGE 1692 CATEGORY 5 83/00/00 6 PAGES UNCLASSIFIED DOCUMENT

UTTL: Impacts of automation - Automation and flight test engineering

AUTH: A/DIJKSHOORN, W.

PAA: A/(Fokker, Schiphol, Netherlands)

CIO: NETHERLANDS

IN: Flight testing today: Innovative management and technology; Proceedings of the Fourteenth Annual Symposium, Newport Beach, CA, August 15-19, 1983 (A85-28632 12-01). Lancaster, CA, Society of Flight Test Engineers, 1983, p. 1.2-1 to 1.2-6.

MAJS: / *AERONAUTICAL ENGINEERING/ *AUTOMATIC CONTROL/ *FLIGHT MANAGEMENT SYSTEMS/ * FLIGHT TESTS

MINS: / COMPUTER AIDED DESIGN/ DATA TRANSMISSION/ MANAGEMENT ANALYSIS/ ONBOARD DATA PROCESSING/ PERFORMANCE PREDICTION/ WORKLOADS (PSYCHOPHYSIOLOGY)

ABA: G.R.

ABS: The technical consequences of automation in flight test programs are examined, taking into account variations in workload, requirements for the transportation of data, and aspects of on-board computation. Developments in automation with respect to flight test measurement are investigated. The flight test management considered can be characterized by five phases, including logistics, preparations, test, presentation, and generalization. A description is provided of an automated system which highly improve given to coherence in test activities, the rewards of adequate result prediction, and the prerequisites of automation.

....

85A26804 ISSUE 11 PAGE 1541 CATEGORY 33 83/00/00 6 PAGES UNCLASSIFIED DOCUMENT COPYRIGHT

UTTL: The relationship between an advanced avionic system architecture and the elimination of the need for an Avionics Intermediate Shop (AIS)

AUTH: A/ABRAHAM, S. J.

PAA: A/(General Dynamics Corp., Fort Worth, TX)

CIO: UNITED STATES

IN: AUTOTESTCON '83; Proceedings of the Conference, Fort Worth, TX, November 1-3, 1983 (A85-26776 11-59). New York, Institute of Electrical and Electronics Engineers, Inc., 1983, p. 206-211.

MAJS: / *AIRCRAFT MAINTENANCE/ *AVIONICS/ *COST ANALYSIS/ *ELECTRONIC MODULES/ * ELECTRONIC PACKAGING/ *SPARE PARTS

MINS: / AEROSPACE ENGINEERING/ LIFE CYCLE COSTS/ SYSTEMS ENGINEERING/ VERY LARGE SCALE INTEGRATION/ VHSIC (CIRCUITS)

ABA: O.C.

ABS: While Avionics Intermediate Shops (AISs) have in the past been required for military aircraft, the emerging VLSI/VHSIC technology has given rise to the possibility of novel, well partitioned avionics system architectures that obviate the high spare parts costs that formerly prompted and justified the existence of an AIS. Future avionics may therefore be adequately and economically supported by a two-level maintenance system. Algebraic generalizations are presented for the analysis of the spares costs implications of alternative design partitioning schemes for future avionics.

....

85A24795*# ISSUE 10 PAGE 1347 CATEGORY 18 85/02/00 4 PAGES UNCLASSIFIED DOCUMENT

UTTL: Expanding role for autonomy in military space

AUTH: A/EVANS, D. D.; B/GAJEWSKI, R. R.

PAA: A/(California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA); B/(USAF, Space Technology Center, Kirtland AFB, NM)

CORP: Jet Propulsion Lab., California Inst. of Tech., Pasadena.; Air Force Space Technology Center, Kirtland AFB, N. Mexico.

CIO: UNITED STATES; Aerospace America (ISSN 0740-722X), vol. 23, Feb. 1985, p. 74-77.

MAJS: /*AUTONOMY/ *MILITARY SPACECRAFT

MINS: /AIRBORNE/SPACEBORNE COMPUTERS/ ARTIFICIAL INTELLIGENCE/ EXPERT SYSTEMS/ FAULT TOLERANCE/ ONBOARD DATA PROCESSING

ABA: M.S.K.

ABS: The Jet Propulsion Laboratory is currently transferring satellite on-board autonomy technology to the USAF for use in military spacecraft as a means of lowering the ground support requirements. The techniques were proven on the Viking and Voyager spacecraft and permitted on-board fault detection and correction. New military satellites will incorporate an autonomous redundancy and maintenance management subsystem in an on-board computer, while the system will still be subject to ground-based safing commands for situations demanding deeper analyses. A level 5 autonomy will need 256 kb memory, 10 Mb nonvolatile data storage and 50 W power and will weigh 20 kg. Systems will be periodically checked and compared with an ideal in the data base. Deviations detected will result in a rollback and redundant examination by two microprocessors, which can initiate correction commands until operational criteria are met. The development of the expert systems to the point that they satisfy military specifications is expected to take 10 yr.

....

85A13194# ISSUE 3 PAGE 287 CATEGORY 20 RPT#: IAF PAPER 84-314 84/10/00 11 PAGES UNCLASSIFIED DOCUMENT

UTTL: H2/O2/Al engines and their application to OTV's

AUTH: A/CUTLER, A. H.

PAA: A/(California, University, La Jolla, CA)

CIO: UNITED STATES; International Astronautical Federation, International Astronautical Congress, 35th, Lausanne, Switzerland, Oct. 7-13, 1984. 11 p.

MAJS: / *ALUMINUM/ *HYDROGEN OXYGEN ENGINES/ *ORBIT TRANSFER VEHICLES/ *PROPULSION SYSTEM PERFORMANCE/ *ROCKET ENGINES/ *SPACECRAFT PROPULSION

MINS: / COSTS/ PROPULSIVE EFFICIENCY/ SCAVENGING/ SPACE MISSIONS

ABA: G.R.

ABS: The addition of aluminum to a fixed available amount of cryogens greatly increases the total impulse available. The present investigation is, therefore, concerned with the possibility to utilize aluminum available in low earth orbit (LEO) for an employment in propellants. The required aluminum could, for instance, be made available by having the Space Shuttle leave its external tank in orbit. It is expected that the addition of an Orbital Transfer Vehicle (OTV) would reduce the cost of orbit raising. The use of aluminum fueled engines for the OTV's is considered. Attention is given to OTV economics, the use of aluminum fueled engines to reduce the high cost of prospective manned missions to the moon and planets, and questions of engine performance.

....

84X76865 CATEGORY 6 84/06/12 2 PAGES UNCLASSIFIED DOCUMENT US GOV AGENCIES

UTTL: MBB specifications for A-320 fault detection system

AUTH: A/NAZARETIAN, R.

CORP: Joint Publications Research Service, Arlington, Va. In its West Europe Report: Sci. and Technol. (JPRS-WST-84-012-L) p 26-27 (SEE X84-76859 1831)

CIO: FRANCE; Transl. into ENGLISH from Air et Cosmos Paris), 31 Mar. 1984 p 17

MAJS / *A-320 AIRCRAFT/ *AIRCRAFT CONTROL/ *CONTROL QUIPMENT/ *EUROPEAN AIRBUS

MINS: A-310 AIRCRAFT/ AUTOMATIC CONTROL/ MICROPROCESSORS

....

84X74856# CATEGORY 6 RPT#: AD-B080219L ASD(ENE)-TR-83-5012 CNT#: AF

PROJ. 2479 83/09/00 116 PAGES UNCLASSIFIED DOCUMENT US GOV AGENCIES

UTTL: Onboard test (OBT) improvement project. Phase II. (Formerly BIT/SIT) (Built-in Test/System Integrated Test) improvement project)

TLSP: Final Report, Dec. 1979 - Jun. 1983

AUTH: A/FERCH, B. C.

CORP: Aeronautical Systems Div., Wright-Patterson AFB, Ohio. CSS: (Directorate of Support Systems Engineering.)

CIO: UNITED STATES

MAJS: / *CIRCUIT BOARDS/ *FIGURE OF MERIT/ *LIFE CYCLE COSTS/ *ONBOARD EQUIPMENT/ * PRINTED CIRCUITS/ *REQUIREMENTS/ *SYSTEM EFFECTIVENESS/ *WARNING SYSTEMS

MINS: / ACCELERATED LIFE TESTS/ AVIONICS/ EVALUATION/ FAULT TOLERANCE/ LIFE (DURABILITY)/ MILITARY AIRCRAFT/ PERFORMANCE TESTS/ PROVING/ RELIABILITY ENGINEERING/ SYSTEM EFFECTIVENESS/ WEAPON SYSTEMS

....

84X71619# CATEGORY 32 RPT#: AD-B076263L NAVMAT-PUB-9405 DARCOM/PAM-34-1 AFLC-PAM-800-39 AFSC-PAM-800-39 81/03/19 223 PAGES UNCLASSIFIED DOCUMENT US GOV AGENCIES

UTTL: Joint DARCOM/NMC/AFLC/AFSC/commanders built-in-test design guide

CORP: Naval Material Command, Washington, D. C.

CIO: UNITED STATES

MAJS: / *AUTOMATIC TEST EQUIPMENT/ *COMMUNICATION EQUIPMENT/ *COMPUTERS/ *MAINTENANCE/ *RADAR EQUIPMENT

MINS: / COMPUTER COMPONENTS/ COMPUTER PROGRAMS/ COST EFFECTIVENESS/ EVALUATION/ HANDBOOKS/ LOGISTICS/ OPTIMIZATION/ PROCEDURES/ RELIABILITY ENGINEERING/ SYSTEMS ENGINEERING/ TRADEOFFS/ WEAPON SYSTEMS[A

....

84N34500# ISSUE 24 PAGE 3866 CATEGORY 19 RPT#: INPE-3244-PRE/590 84/08/00 8 PAGES UNCLASSIFIED DOCUMENT DCAF F002949

UTTL: A fault-tolerant multiprocessing unit for on-board satellite supervision and control

AUTH: A/DEPAULA, A. R., JR.; B/MARTINS, R. C. O.

CORP: Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil). AVAIL.NTIS

SAP: HC A02/MF A01

CIO: BRAZIL Presented at the 5th Congr. Brasileiro de Automatica, and at the 1st Congr. Latino-Am. de Automatica, Campina Grande, Brazil, 3-6 Sep. 1984

MAJS: / *FAULT TOLERANCE/ *MULTIPROCESSING (COMPUTERS)/ *ONBOARD DATA PROCESSING/ * ONBOARD EQUIPMENT

MINS: / ARTIFICIAL SATELLITES/ ERRORS/ HARDWARE/ HIERARCHIES/ MODULARITY/ REDUNDANCY/ STANDARDS

ABA: Author

ABS: This work presents a standard for fault-tolerant 16-bit multiprocessing systems to be utilized on board of satellites for their supervision and control. The systems, defined by the proposed standard, are characterized by their modularity, easy adaptation to different satellites and tolerances to single-point failures. The methodology for the development of such a standard is also outlined. This is based on the organization of the fault detection, analysis/ confinement and recovery techniques according to the logical hierarchical layers of the system. The proposed multiprocessing system is constituted by a set of 16-bit multiprocessing units interconnected by redundant busses. The techniques for fault-tolerance in a typical multiprocessing unit are presented stressing their structural interrelationship according to the following system layers: hardware, operating system and applicative processes.

....

84N26573# ISSUE 17 PAGE 2586 CATEGORY 6 84/02/00 20 PAGES UNCLASSIFIED DOCUMENT DCAF E070125

UTTL: Failure Identification Module (FIM) for digital control systems — avionics

AUTH: A/DAHL, G.

CORP: Bodenseewerk Geraetetechnik G.m.b.H., Ueberlingen (West Germany). AVAIL.NTIS

SAP: HC A25/MF A01 In DFVLR Proc. of 12th Symp. on Aircraft Integrated Data Systems p 183-202 (SEE N84-26565 17-01)

CIO: GERMANY, FEDERAL REPUBLIC OF

MAJS: /*AVIONICS/ *DATA RECORDING/ *FAILURE ANALYSIS/ *IN-FLIGHT MONITORING

MINS: / AIRBORNE/SPACEBORNE COMPUTERS/ AIRCRAFT MAINTENANCE/ COST REDUCTION/ ONBOARD DATA PROCESSING

ABA: Author (ESA)

ABS: It is argued that trouble shooting of avionic systems is too expensive. Defects reported to the maintenance crew or other failures indicated on the maintenance panel are often not confirmed in the following trouble shooting, because of incorrect or incomplete objections or because of unspecified or unconsidered disturbances to the unit. To make the trouble shooting easier and more reliable and to decrease the rate of unconfirmed defects a failure identification module (FIM) is proposed. During the preflight and the postflight test phase, as well as during the operation phase of the controller, this FIM records essential data of the controller and its safety systems. The data are stored in a non volatile memory, so are available despite a power failure. At the end of the mission the automatic analysis indicates the defective line replaceable unit on a failure display with high probability.

....

84N14754# ISSUE 5 PAGE 724 CATEGORY 61 83/08/00 6 PAGES UNCLASSIFIED DOCUMENT DCAF E003091

UTTL: Onboard software testing and qualification

AUTH: A/LONGONI, F.; B/REDAELLI, R.

CORP: LABEN Space Instrumentation and Systems, Milan (Italy). AVAIL.NTIS

SAP: HC A13/MF A01 In ESA Software Eng. p 201-206 (SEE N84-14729 05-61)

CIO: ITALY

MAJS: / *ACCEPTABILITY/ *COMPUTER PROGRAMS/ *ONBOARD DATA PROCESSING/ *PROGRAM VERIFICATION (COMPUTERS)

MINS: / AIRBORNE/SPACEBORNE COMPUTERS/ DOCUMENTATION/ FLIGHT TESTS/ REAL TIME OPERATION/ SYSTEMS SIMULATION

ABA: Author (ESA)

ABS: Test requirements and objectives for on board software, test environments, and test methodologies are described, from static testing to integration and dynamic testing with real time simulation of the flight hardware, and final acceptance and qualification. The staff responsibilities during the different phases are outlined, together with the documentation produced. Retesting, in case of faults detected after the

qualification, is covered.

....

84A46661 ISSUE 23 PAGE 3434 CATEGORY 61 83/00/00 18 PAGES UNCLASSIFIED DOCUMENT

UTTL: Integrated realtime software for both airborne flight test systems and PCM ground stations

AUTH: A/TROVER, W. F.

PAA: A/(Teledyne Controls, Los Angeles, CA)

CIO: UNITED STATES

IN: ITC/USA/ '83; Proceedings of the International Telemetering Conference, San Diego, CA, October 24-27, 1983 (A84-46601 23-32). Research Triangle Park, NC, Instrument Society of America, 1983, p. 717-734.

MAJS: / *AIRBORNE/SPACEBORNE COMPUTERS/ *COMPUTER PROGRAMS/ *COMPUTER SYSTEMS DESIGN/ *FLIGHT TESTS/ *GROUND STATIONS/ *PULSE CODE MODULATION

MINS: / DATA ACQUISITION/ DATA RECORDING/ DATA REDUCTION/ IN-FLIGHT MONITORING/ ONBOARD DATA PROCESSING/ PCM TELEMETRY/ PROGRAM VERIFICATION (COMPUTERS)/ REAL TIME OPERATION/ SYSTEMS INTEGRATION

ABA: I.H.

ABS: The main features of some computer software for real-time, on-board evaluation of aircraft test data are described. The software can be used either on-board an aircraft or at a PCM ground station. Among the data provided by the software are: stacked or overlayed scrolling EU curves, limit exceed test data, alarm generation; tabular EU data presentations; hard copy of CRT presentations; or classical raw data strip recordings. Incorporated into the software are facilities for semi-automatic calibration of sensors and tape headers for automatic PCM tape reading by a ground station. The software can be linked to data reduction software on the PCM ground station for the generation loading and test of a data cycle map in the on-board PCM system. Several block diagrams and schematic drawings of a computer system which uses the software are provided.

....

83A49578# ISSUE 24 PAGE 3543 CATEGORY 1 RPT#: AIAA PAPER 83-2448 83/10/00 7 PAGES UNCLASSIFIED DOCUMENT COPYRIGHT

UTTL: Avionics built-in-test effectiveness and life cycle cost

AUTH: A/PALAZZO, C.; B/ROSENFELD, M.

PAA: B/(Grumman Aerospace Corp., Bethpage, NY)

CIO: UNITED STATES; American Institute of Aeronautics and Astronautics, Aircraft Design, Systems and Technology Meeting, Fort Worth, TX, Oct. 17-19, 1983. 7 p.

MAJS: / *AVIONICS/ *ELECTRONIC EQUIPMENT TESTS/ *LIFE CYCLE COSTS/ *MILITARY TECHNOLOGY/ *SYSTEM EFFECTIVENESS

MINS: / COMPONENT RELIABILITY/ ERROR ANALYSIS/ PERFORMANCE TESTS/ WEAPON SYSTEMS

ABA: Author

ABS: Results of an investigation into the effectiveness of built-in-test (BIT) on aircraft weapon systems and its impact on operational assessability and life cycle cost (LCC) are presented herein. BIT effectiveness was found to be high in current operational systems although errors in data collection and interpretation precluded highly accurate measurements. Low BIT effectiveness had a negligible effect on logistic support costs (LSC), particularly for avionic units with moderate to high reliabilities. It was concluded that a major reason for improving BIT effectiveness was to increase its ability to determine the status of mission essential subsystems (i.e., increase operational assessability).

....

83A45473*# ISSUE 21 PAGE 3097 CATEGORY 16 RPT#: AIAA PAPER 81-2101 CNT#: NAS9-14444 83/10/00 7 PAGES UNCLASSIFIED DOCUMENT

UTTL: Organizing Space Shuttle parametric data for maintainability

AUTH: A/ANGIER, R. C.

PAA: A/(IBM Corp., Houston, TX)

CORP: IBM Federal Systems Div., Houston, Texas.

CIO: UNITED STATES; (American Institute of Aeronautics and Astronautics, Computers in Aerospace Conference, 3rd, San Diego, CA, Oct. 26-28, 1981) Journal of Guidance, Control, and Dynamics (ISSN 0731-5090), vol. 6, Sept.-Oct. 1983, p. 407-413.

MAJS: / *DATA MANAGEMENT/ *ONBOARD DATA PROCESSING/ *SPACE SHUTTLE ORBITERS/ *SPACE TRANSPORTATION SYSTEM FLIGHTS

MINS: / CONFIGURATION MANAGEMENT/ DATA INTEGRATION/ DATA STRUCTURES/ HIERARCHIES / MANAGEMENT INFORMATION SYSTEMS/ MISSION PLANNING

ABA: Author

ABS: A model of organization and management of Space Shuttle data is proposed. Shuttle avionics software is parametrically altered by a reconfiguration process for each flight. As the flight rate approaches an operational level, current methods of data management would become increasingly complex. An alternative method is introduced, using modularized standard data, and its implications for data collection, integration, validation, and reconfiguration processes are explored. Information modules are cataloged for later use, and may be combined in several levels for maintenance. For each flight, information modules can then be selected from the catalog at high level. These concepts take advantage of the reusability of Space Shuttle information to reduce he cost of reconfiguration as flight experience increases.

....

No.: A2 **Title:** Fault Tolerant Avionics Suite

Operations Requirement:

Avionics systems must provide for higher reliability by providing levels of fault tolerance in support of manrated system availability.

Rationale:

To support onboard checkout and mission success the entire avionics suite must be designed to provide that level of fault tolerance required to assure that the system is available when required. This is best accomplished by assuring the robustness of all mission critical systems, and providing fault tolerance where it is required.

Sample Concept:

Future systems must be designed such that systems in general can be dynamically configured to provide for more than one function. Should an allocated processor or sub-system fail, another processor with a lesser priority function should be assigned to reconfigure and perform the function of the failed processor. This forces a high degree of commonality, and distributed processing. Integrated Fault Tolerant Avionics Suite (IFTAS) is an example of this technique.

Technology Requirement:

Distributed processing, layered architectures, commonality. IFTAS development.

Technology References:

NASA/RECON:

86X10264, 86X10263, 86N20475, 86N20472, 86N20402, 86A47511,
86A47442, 86A37043, 86A33194, 86A28062, 86A11452, 85X10244,
85N30643, 85N23337, 85N16896, 85N16752, 85N11610, 85N11590,
85N10711, 85A44565, 85A43489, 85A34179, 85A25108, 85A24795,
85A17876, 85A17344, 84K10537, 84A41699, 84A26771, 84A26768,
84A43946, 84A10052, 84A10001, 83N36337, 83N13819, 83A22825,
82A14714, 82A13490

See also E, Power

86X10264*# ISSUE 7 CATEGORY 37 RPT#: NASA-TM-88698 NAS 1.15:88698 85/00/00 263 PAGES UNCLASSIFIED DOCUMENT US GOV AGENCIES AND CONTRACTORS

UTTL: Proceedings of NASA Automation and Robotics Information Exchange Workshop. Volume 2, part B: Presentations Material, Wednesday Session

CORP: National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex. MFC: E3

CIO: UNITED STATES; Workshop held at Houston, Tex., 13-17 May 1985

MAJS: /*ARTIFICIAL INTELLIGENCE/ *FAULT TOLERANCE/ *MAN MACHINE SYSTEMS/ *ORBITAL SPACE STATIONS/ *REMOTE SENSING/ *ROBOTICS/ *WEATHER FORECASTING

MINS: /COMPUTER VISION/ CONTROL EQUIPMENT/ STRUCTURAL DESIGN CRITERIA/ TELEOPERATORS

ABA: B.G.

ABS: Topics presented include: optical sensing; man machine interfaces; fault tolerance systems; fiber optic technology; robotics; artificial intelligence; remote satellite servicing; design considerations for support of robotics; advance teleoperator technology; orbital space station control systems; and cargo operations.

....

86X10263*# ISSUE 7 CATEGORY 37 RPT#: NASA-TM-88616 NAS 1.15:88616 85/00/00 529 PAGES UNCLASSIFIED DOCUMENT US GOV AGENCIES AND CONTRACTORS

UTTL: Proceedings of NASA Automation and Robotics Information Exchange Workshop. Volume 2, part A: Presentations Material

CORP: National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex. MFC: E3

CIO: UNITED STATES; Workshop held at Houston, Tex., 13-17 May 1985

MAJS: /*ARTIFICIAL INTELLIGENCE/ *CONTROL EQUIPMENT/ *EXPERT SYSTEMS/ *FAULT TOLERANCE/ *HUMAN FACTORS ENGINEERING/ *MAN MACHINE SYSTEMS/ *ORBITAL SPACE STATIONS/ *ROBOTICS/ *SYSTEMS ENGINEERING

MINS: /AVIONICS/ COMPUTER VISION/ LIFE SUPPORT SYSTEMS/ MISSION PLANNING/ REMOTE SENSING/ STRUCTURAL DESIGN CRITERIA/ WEATHER FORECASTING

ABA: B.G.

ABS: Presentations covered the following topics: prototype expert systems; life support system control; systems engineering; computer vision; helmet mounted displays; artificial intelligence; robotics; space station mission planning; payload automation; power systems automation; human factors engineering; man machine interfaces; remote satellite servicing; weather forecasting systems; and fault tolerance computing.

....

86N20475*# ISSUE 11 PAGE 1733 CATEGORY 18 RPT#: NASA-CR-177840 NAS 1.26:177840 MDC-H1341A-VOL-2 CNT#: NAS5-28082 85/12/00 7 VOLS 435 PAGES UNCLASSIFIED DOCUMENT

UTTL: Space station data system analysis/architecture study. Task 2: Options development, DR-5. Volume 2: Design options

CORP: McDonnell-Douglas Astronautics Co., Huntington Beach, Calif. AVAIL.NTIS SAP: HC A19/MF A01

CIO: UNITED STATES

MAJS: /*ARCHITECTURE (COMPUTERS)/ *COMMUNICATION NETWORKS/ *COMPUTER SYSTEMS DESIGN/ *COMPUTER SYSTEMS PROGRAMS/ *END-TO-END DATA SYSTEMS/ *ORBITAL SPACE STATIONS/ *SPACE COMMUNICATION/ *SYSTEMS ANALYSIS

MINS: /AUTONOMY/ COMPUTER INFORMATION SECURITY/ DATA BASE MANAGEMENT SYSTEMS/ FAULT TOLERANCE/ TIME MEASUREMENT/ WORKSTATIONS

ABA: M.G.

ABS: The primary objective of Task 2 is the development of an information base that will support the conduct of trade studies and provide sufficient data to make key design/programmatic decisions. This includes: (1) the establishment of option categories that are most likely to influence Space Station Data System (SSDS) definition; (2) the identification of preferred options in each category; and (3) the characterization of these opt with respect to performance attributes, constraints, cost and risk. This volume contains the options development for the design category. This category comprises alternative structures, configurations and techniques that can be used to develop designs that are responsive to the SSDS requirements. The specific areas discussed are software, including data base management and distributed operating systems; system architecture, including fault tolerance and system growth/automation/autonomy and system interfaces; time management; and system security/privacy. Also discussed are space communications and local area networking.

....

86N20472*# ISSUE 11 PAGE 1732 CATEGORY 18 RPT#: NASA-CR-177839 NAS 1.26:177839 MDC-H1343A CNT#: NAS5-28082 85/05/00 379 PAGES UNCLASSIFIED DOCUMENT

UTTL: Space station data system analysis/architecture study. Task 2: Options development DR-5. Volume 1: Technology options

CORP: McDonnell-Douglas Astronautics Co., Huntington Beach, Calif.; Ford Aerospace and Communications Corp., Sunnyvale, Calif.; IBM Federal Systems Div., Cape Canaveral, Fla.; Radio Corp. of America, Hollywood, Calif. AVAIL.NTIS

SAP: HC A17/MF A01

CIO: UNITED STATES; Prepared in cooperation with Ford Aerospace Communications Corp., Sunnyvale, Calif., IBM Federal Systems Div., Cape Canaveral, Fla. and Radio Corporation of America, Hollywood, Calif.

MAJS: /*ARCHITECTURE (COMPUTERS)/ *COMPUTER SYSTEMS DESIGN/ *COMPUTER SYSTEMS PROGRAMS/ *DATA STORAGE/ *END-TO-END DATA SYSTEMS/ *ORBITAL SPACE STATIONS/ * SYSTEMS ANALYSIS

MINS: /ARTIFICIAL INTELLIGENCE/ COMMUNICATION CABLES/ FAULT TOLERANCE/ MAN MACHINE SYSTEMS/ SIGNAL TRANSMISSION/ SOFTWARE TOOLS/ SPEECH RECOGNITION

ABA: M.G.

ABS: The second task in the Space Station Data System (SSDS) Analysis/Architecture Study is the development of an information base that will support the conduct of trade studies and provide sufficient data to make key design/programmatic decisions. This volume identifies the preferred options in the technology category and characterizes these options with respect to performance attributes, constraints, cost, and risk. The technology category includes advanced materials, processes, and techniques that can be used to enhance the implementation of SSDS design structures. The specific areas discussed are mass storage, including space and round on-line storage and off-line storage; man/machine interface; data processing hardware, including flight computers and advanced/fault tolerant computer architectures; and software, including data compression algorithms, on-board high level languages, and software tools. Also discussed are artificial intelligence applications and hard-wire communications.

....

86N20402# ISSUE 11 PAGE 1721 CATEGORY 6 85/09/00 15 PAGES UNCLASSIFIED DOCUMENT

UTTL: Redundancy management of sychronous and asynchronous systems

AUTH: A/PAPADOPOULOS, G. M.

CORP: Massachusetts Inst. of Tech., Cambridge. CSS: (Lab. for Computer Science.) AVAIL.NTIS

SAP: HC A07/MF A01 In AGARD Fault Tolerant Hardware/Software Architecture 15 p (SEE N86-20399 11-08)

CIO: UNITED STATES

MAJS: /*ALGORITHMS/ *FAILURE ANALYSIS/ *FAULT TOLERANCE/ *REDUNDANCY/ *SYNCHRONISM

MINS: /AVIONICS/ CONTROL SYSTEMS DESIGN/ HEURISTIC METHODS

ABA: Author

ABS: While asynchronous systems may initially appear attractive due to the uncoupling the channels, the cross-channel interactions are much greater than what might be expected. Both synchronous and asynchronous systems share the burden of cross-channel consistency maintenance, the requirement that inputs and internal states are not allowed to diverge too far from each other. In fact, consistency maintenance often dominates the engineering process in a correctly designed system. In asynchronous systems, consistency maintenance takes the form of cross-channel equalization along with techniques for handling discrete changes in operating mode. In synchronous systems, consistency maintenance is implemented with source congruence algorithms. Synchronous and asynchronous systems must both support reliable resolution of redundant channel outputs, the process of isolating correct effectuator commands from faulty ones. A correctly designed synchronous system may rely on exact bit-for-bit voting to isolate faulty channels, while an asynchronous system must employ more heuristic means such as threshold and reasonableness tests. This research concludes that data synchronous principle is the approach of choice. the systems provide general purpose vehicles on which increasingly complex and diverse flight critical applications may execute.

....

86A47511*# ISSUE 23 PAGE 3403 CATEGORY 6 RPT#: AIAA PAPER 86-2030 86/08/00 10 PAGES UNCLASSIFIED DOCUMENT

UTTL: Design considerations for flight test of a fault inferring nonlinear detection system algorithm for avionics sensors

AUTH: A/CAGLYAN, A. K.; /GODIWALA, P M.; C/MORRELL, F. R.

PAA: B/(Charles River Analytics, Inc., Cambridge, MA); C/(NASA, Langley Research Center, Hampton, VA)

CORP: Charles River Analytics, Inc., Cambridge, Mass.; National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

CIO: UNITED STATES; AIAA, Guidance, Navigation and Control Conference, Williamsburg, VA, Aug. 18-20, 1986. 10 p.

MAJS: /*AIRCRAFT CONTROL/ *AVIONICS/ *FALSE ALARMS/ *FAULT TOLERANCE/ *FLIGHT TESTS / *KALMAN FILTERS/ *MULTISENSOR APPLICATIONS

MINS: /AIRBORNE/ SPACEBORNE COMPUTERS/ AIRCRAFT LANDING/ ALGORITHMS/ ERROR DETECTION CODES/ GUIDANCE SENSORS

ABA: Author

ABS: This paper summarizes the modifications made to the design of a fault inferring nonlinear detection system (FINDS) algorithm to accommodate flight computer constraints and the resulting impact on the algorithm performance. An overview of the flight data-driven FINDS algorithm is presented. This is followed by a brief analysis of the effects of modifications to the algorithm on program size and execution speed. Significant improvements in estimation performance for the aircraft states and normal operating sensor biases, which have resulted from improved noise design parameters and a new steady-state wind model, are documented. The aircraft state and sensor bias estimation performances of the algorithm's extended Kalman filter are presented as a function of update frequency of the piecewise constant filter gains. The results of a new detection system strategy and failure detection performance, as a function of an update frequency, are also presented.

....

86A47442# ISSUE 23 PAGE 3409 CATEGORY 8 RPT#: AIAA PAPER 86-2092 CNT#: DAAG29-84-K-0048 86/00/00 10 PAGES UNCLASSIFIED DOCUMENT

UTTL: A theory for fault-tolerant flight control combining expert system and analytical redundancy concepts

AUTH: A/STENGEL, R. F.; B/HANDELMAN, D. A.

PAA: A/(Princeton University, NJ)

CIO: UNITED STATES

IN: Guidance, Navigation and Control Conference, Williamsburg, VA, August 18-20, 1986, Technical Papers (A86-47401 23-63). New York, American Institute of Aeronautics and Astronautics, 1986, p. 375-384.

MAJS: /*CONTROL SYSTEMS DESIGN/*EXPERT SYSTEMS / *FAILURE ANALYSIS/ *FAULT TOLERANCE/ *FLIGHT CONTROL/ *STRUCTURAL FAILURE

MINS: /ALGORITHMS/ ARTIFICIAL INTELLIGENCE/ COMPUTER SYSTEMS PROGRAMS/ FAILURE MODES/ HEURISTIC METHODS/ KALMAN FILTERS/ REAL TIME OPERATION/ REDUNDANCY

ABA: Author

ABS: This paper presents a theory for rule-based fault-tolerant flight control. The objective is to define methods for designing control systems capable of accommodating a wide range of aircraft failures, including sensor, control, and structural failures. A software architecture is described that integrates quantitative analytical redundancy techniques and heuristic expert system concepts for the purpose of in-flight, real-time fault tolerance. The resultant controller uses a rule-based expert system approach to transform the problem of failure accommodation task scheduling and selection into a problem of search. Control system performance under sensor and control failures is demonstrated using linear discrete-time deterministic simulations of a tandem-rotor helicopter's dynamics. It is found that the rule-based control theory can be used to enhance existing redundancy management systems. This approach to control system design also provides inherent parallelism for computational speed, smooth integration of algorithmic and heuristic computation, a search-based decision-making mechanism, straightforward system organization and debugging, and an incremental growth capability.

....

86A37043*# ISSUE 16 PAGE 2403 CATEGORY 61 CNT#: NAG1-613 86/06/00 6 PAGES UNCLASSIFIED DOCUMENT

UTTL: Reconfiguration algorithms for tree architectures using sub-tree oriented fault tolerance

AUTH: A/LOWRIE, M. B.; B/FUCHS, W. K.

PAA: B/(Illinois, University, Urbana)

CORP: Illinois Univ., Urbana.

CIO: UNITED STATES; International Conference on Fault-Tolerant Systems and Diagnostics, Brno, Czechoslavakia, June 1986, Paper. 6 p. MAJS: /*ARCHITECTURE (COMPUTERS)/ *COMPUTER SYSTEMS DESIGN/ *CONCURRENT PROCESSING / *FAULT TOLERANCE/ *REDUNDANCY/ *TREES (MATHEMATICS)

MINS: /ALGORITHMS/ DATA LINKS/ DIGITAL COMPUTERS/ RELIABILITY ENGINEERING/ SWITCHING CIRCUITS/ SYSTEM FAILURES

ABA: Author

ABS: An approach to reconfiguration in tree architectures has been developed in which redundant processors are allocated at the leaves. The scheme is called sub-tree oriented fault tolerances (SOFT) and is capable of tolerating both link failures as well as multiple processor failures. In this paper, the SOFT scheme is examined from the perspective of reconfigurability. Specific algorithms are presented for reconfiguration.

....

86A33194 ISSUE 14 PAGE 2080 CATEGORY 60 85/00/00 6 PAGES UNCLASSIFIED DOCUMENT

UTTL: Fault-tolerant and fail-safe microcomputer systems for modern automatic process control by redundancy

AUTH: A/SCHRODT, E.

PAA: A/(Siemens AG, Karlsruhe, West Germany)

CIO: GERMANY, FEDERAL REPUBLIC OF

IN: A bridge between control science and technology. Volume 5 (A86-33181 14-63). Oxford and New York, Pergamon Press, 1985, p. 2739-2744.

MAJS: /*AUTOMATIC CONTROL/ *CONTROL SYSTEMS DESIGN/ *FAIL-SAFE SYSTEMS/ *FAULT TOLERANCE/ *MICROCOMPUTERS/ *PROCESS CONTROL (INDUSTRY)

MINS: /COMPUTER SYSTEMS DESIGN/ DESIGN ANALYSIS/ HIERARCHIES/ MAINTENANCE/ REDUNDANCY

ABA: Author

ABS: Fault-tolerant automation subsystems have to be added to a modern distributed process control system in order to fulfill the most stringent requirements in view of reliability and safety of process control. The paper describes design features and experience with both new 1-out-of-2 hot standby system and 2-out-of-3 system, each one operating in a fully synchronized mode. The subsystems have the same scope of functions as a basic non-redundant system and are suitable for non-stop process control. Operator communication, observation and configuration can be carried out either from a central control room via a bus system and special operating subsystems, or from a direct coupled local operating station.

....

86A28062 ISSUE 11 PAGE 1593 CATEGORY 62 CNT#: NSF ECS-82-05188 86/03/00 12 PAGES UNCLASSIFIED DOCUMENT

UTTL: Fault-tolerance considerations in large, multiple-processor systems

AUTH: A/KUHL, J. G.; B/REDDY, S. M.

PAA: B/(Iowa, University, Iowa City)

CIO: UNITED STATES; Computer (ISSN 0018-9162), vol. 19, March 1986, p. 56-67. Research supported by the Semiconductor Research Corp. and Army.

MAJS: /*COMPUTER SYSTEMS DESIGN/ *FAULT TOLERANCE/ *MULTIPROCESSING (COMPUTERS)

MINS: /COMMUNICATION NETWORKS/ DIAGNOSIS/ DISTRIBUTED PROCESSING/ GRAPH THEORY/ INTERPROCESSOR COMMUNICATION/ MASKING/ REDUNDANCY ENCODING/ ROBUSTNESS (MATHEMATICS)/ TASKS

ABA: G.R.

ABS: The present paper is concerned with computing systems, called 'multicomputers', in which a large number of basically autonomous processing elements are interconnected by a structure which allows high-bandwidth communication between them. The complexity of such systems makes it necessary to employ a new approach to the problems of dealing with hardware malfunctions. A survey is, therefore, provided of the techniques for achieving fault tolerance in large multicomputers. Attention is given to the general framework for fault tolerance in distributed multicomputers, fault tolerance through replication and masking, fault-tolerance-tolerance considerations for communication facilities, and fault tolerance through diagnosis, repair, and recovery.

....

86A11452*# ISSUE 2 PAGE 196 CATEGORY 61 RPT#: AIAA PAPER 85-6022 85/00/00 8 PAGES UNCLASSIFIED DOCUMENT

UTTL: Performance analysis of a fault inferring nonlinear detection system algorithm with integrated avionics flight data

AUTH: A/CAGLAYAN, A. K.; B/GODIWALA, P. M.; C/MORRELL, F. R.

PAA: B/(Charles River Analytics, Inc., Cambridge, MA); C/(NASA, Langley Research Center, Hampton, VA)

CORP: Charles River Associates, Inc., Cambridge, Mass.; National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

CIO: UNITED STATES

IN: Computers in Aerospace Conference, 5th, Long Beach, CA, October 21-23, 1985, Technical Papers (A86-11401 02-59). New York, AIAA, 1985, p. 391-398.

MAJS: / *AIRBORNE/SPACEBORNE COMPUTERS/ *AVIONICS/ *FAULT TOLERANCE/ *FLIGHT INSTRUMENTS/ *NONLINEAR SYSTEMS

MINS: /ACCELEROMETERS/ ALGORITHMS/ BOEING 737 AIRCRAFT/ MEMORY (COMPUTERS)/ SYSTEMS INTEGRATION

ABA: Author

ABS: This paper presents the performance analysis results of a fault inferring nonlinear detection system (FINDS) using integrated avionics sensor flight data for the NASA ATOPS B-737 aircraft in a Microwave Landing System (MLS) environment. First, an overview of the FINDS algorithm structure is Then, aircraft state estimate time histories and statistics for the flight data sensors are discussed. This is followed by an explanation of modifications made to the detection and decision functions in FINDS to improve false alarm and failure detection performance. Next, the failure detection and false alarm performance of the FINDS algorithm are analyzed by injecting bias failures into fourteen sensor outputs over six repetitive runs of the five minutes of flight data. Results indicate that the detection speed, failure level estimation, and false alarm performance show a marked improvement over the previously reported simulation runs. In agreement with earlier results, detection speed is faster for filter measurement sensors such as MLS than for filter input sensors such as flight control accelerometers. Finally, the progress in modifications of the FINDS algorithm design to accommodate flight computer constraints is discussed.

....

85X10244# ISSUE 5 CATEGORY 62 RPT#: NASA-TM-77012 NAS 1.15:77012

CNT#: NASW-3541 83/02/00 345 PAGES UNCLASSIFIED DOCUMENT US GOV AGENCIES AND CONTRACTORS

UTTL: Fault tolerant computer systems

AUTH: A/NETT, E.; B/SCHWARTZEL, H. PAT: A/ed.; B/ed.

CORP: National Aeronautics and Space Administration, Washington, D.C.

CIO: GERMANY, FEDERAL REPUBLIC OF; Transl. by Kanner (Leo) Associates, Redwood City, Calif. Presented at Conf. on the State-of-the-Art and Theoret. Approaches for Self-Diagnosing, Fault-Tolerant Computers and Microprocessors in West Germany, Munich, 11-12 Mar. 1982 p 1-322 Transl. into ENGLISH from ""Fehlertolerirende Rechnersysteme, GI Fachtagung'' Munich, v. 54, 11-12 Mar. 1982 p 1-322

MAJS: /*ARCHITECTURE (COMPUTERS)/ *COMPUTER SYSTEMS DESIGN/ *COMPUTER SYSTEMS PROGRAMS/ *CONFERENCES/ *FAULT TOLERANCE

MINS: /COMPUTER COMPONENTS/ COMPUTER SYSTEMS PERFORMANCE/ COMPUTER SYSTEMS SIMULATION/ MULTIPROCESSING (COMPUTERS)/ RELIABILITY

AB: M.G.

ABS: Twenty-tree reports presented at the conference on the state of the art and theoretical approaches for self-diagnosing, fault-tolerant computers and microprocessors in West Germany are compiled. Topic areas include fault-tolerant computer components, self diagnosis and testing, formation of models and simulation, software, architecture, and fault-tolerant multicomputer systems.

....

85N30643 ISSUE 19 PAGE 3332 CATEGORY 60 84/00/00 105 PAGES UNCLASSIFIED DOCUMENT

UTTL: Graceful fault tolerance in large networks of microcomputers TLSP: Ph.D. Thesis

AUTH: A/AGRAWAL, B. K.

CORP: Wayne State Univ., Detroit, Mich.

SAP: Avail: Univ. Microfilms Order No. DA8504841

CIO: UNITED STATES

MAJS: /*COMPUTER NETWORKS/ *DISTRIBUTED PROCESSING/ *FAULT TOLERANCE/ * MICROCOMPUTERS

MINS: /ALGORITHMS/ COMPUTER SYSTEMS PERFORMANCE/ ERROR ANALYSIS/ VERY LARGE SCALE INTEGRATION

ABA: Dissert. Abstr.

ABS: The problem of fault diagnosis in a network of distributed multicomputers is considered and a strategy for repeated reconfiguration is presented in detail to help improve the degree of fault tolerance. The overall

system diagnostibility is shown to be enhanced further by constructing a large network with small well known graphs as its basis and then apply reconfiguration techniques locally in various system partitions and exchanging diagnostic information globally. A detailed description of this new attractive approach is presented along with the diagnostic algorithm suitable for large networks of microcomputers in VLSI based distributed systems. A systematic procedure for defining near optimal fault tolerance graph theoretical networks is investigated which is well suited for multicomputer structures. A distributed algorithm along with a new system diagnostic theory is proposed.

....

85N23337*# ISSUE 13 PAGE 2149 CATEGORY 62 RPT#: NASA-TM-86322 L-15855 NAS 1.15:86322 85/04/00 27 PAGES UNCLASSIFIED DOCUMENT

UTTL: Measurement of SIFT operating system overhead

AUTH: A/PALUMBO, D. L.; B/BUTLER, R. W.

CORP: National Aeronautics and Space Administration. Langley Research Center, Hampton, Va. AVAIL.NTIS

SAP: HC A03/MF A01

CIO: UNITED STATES

MAJS: /*COMPUTER SYSTEMS DESIGN/ *DATA PROCESSING/ *FAULT TOLERANCE/*SOFTWARE ENGINEERING

MINS: /DATA BASE MANAGEMENT SYSTEMS/ ERROR ANALYSIS/ INTERACTIVE CONTROL/ PERFORMANCE TESTS/ SUBROUTINES

ABA: E.A.K.

ABS: The overhead of the software implemented fault tolerance (SIFT) operating system was measured. Several versions of the operating system evolved. Each version represents different strategies employed to improve the measured performance. Three of these versions are analyzed. The internal data structures of the operating systems are discussed. The overhead of the SIFT operating system was found to be of two types: vote overhead and executive task overhead. Both types of overhead were found to be significant in all versions of the system. Improvements substantially reduced this overhead; even with these improvements, the operating system consumed well over 50% of the available processing time.

....

85N16896*# ISSUE 8 PAGE 1091 CATEGORY 6 85/01/00 12 PAGES UNCLASSIFIED DOCUMENT

UTTL: Development and implementation of the verification process for the shuttle avionics system

AUTH: A/SMITH, H. E.; B/FOUTS, W. B.; C/MESMER, J.

PAA: B/(Rockwell International Corp., Downey, Calif.); C/(Rockwell International Corp., Downey, Calif.)

CORP: National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex. AVAIL.NTIS

SAP: HC A25/MF A01 In its Space Shuttle Tech. Conf., Pt. 1 p 64-75 (SEE N85-16889 08-12)

CIO: UNITED STATES

MAJS: /*AIRBORNE/SPACEBORNE COMPUTERS/ *AVIONICS/ *FLIGHT CONTROL/ *SPACE SHUTTLE ORBITERS/ *SPACECRAFT CONTROL

MINS: /COMPUTER PROGRAMS/ CONTROL SYSTEMS DESIGN/ DESIGN ANALYSIS/ DIGITAL SYSTEMS/ FAULT TOLERANCE/ FLIGHT TESTS/ GROUND TESTS/ PROJECT MANAGEMENT/ TEST FACILITIES

ABA: M.G.

ABS: The background of the shuttle avionics system design and the unique drivers associated with the redundant digital multiplexed data processing system are examined. With flight software pervading to the lowest elements of the flight critical subsystems, it was necessary to identify a unique and orderly approach of verifying the system as flight ready for STS-1. The approach and implementation plan is discussed, and both technical problems and management issues are dealt with.

....

85N16752# ISSUE 8 PAGE 1066 CATEGORY 1 84/10/00 6 PAGES UNCLASSIFIED DOCUMENT

UTTL: A weapon system design approach to diagnostics

AUTH: A/NEUMANN, G. W.; B/BATTAGLIA, M.

PAA: A/(Giordano Associates, Inc., Arlington, Va.)

CORP: Naval Electronic Systems Command, Washington, D.C. AVAIL.NTIS

SAP: HC A13/MF A01 In AGARD Design for Tactical Avionics Maintainability 6 p (SEE N85-16731 08-01)

CIO: UNITED STATES

MAJS: /*AVIONICS/ *GOVERNMENT/INDUSTRY RELATIONS/ *MAINTENANCE/ *WEAPON SYSTEMS

MINS: /ARTIFICIAL INTELLIGENCE/ COMPUTER AIDED DESIGN/ COMPUTER AIDED MANUFACTURING/ COSTS/ EDUCATION/ FAULT TOLERANCE/ SYSTEMS ENGINEERING

ABA: R.S.F.

ABS: Providing a diagnostics capability for today's weapon systems requires a multifaceted combination of hardware, software, and personnel. The approach to providing this capability is fractionated among a number of different communities (e.g., testing, training, human engineering, publication writers). The result is reflected in the field, where the technician has been furnished a myriad of tools and documentation, which is confusing, complex and often contradictory. The result is lengthy repair times and a waste of manpower and dollars. The basic reason for this diagnostic deficiency is the lack of an integrated design approach to providing this capability and the inability to transition technological advancements to weapon systems acquisitions. Recent Department of Defense and U.S. industry efforts to solve this problem are discussed.

....

85N11610# ISSUE 2 PAGE 246 CATEGORY 63 RPT#: AD-P003930 84/06/00 17 PAGES UNCLASSIFIED DOCUMENT

UTTL: Artificial intelligence approaches to monitoring system integrity

AUTH: A/MAXION, R. A.

CORP: Colorado Univ., Boulder. CSS: (Inst. of Cognitive Science.) AVAIL.NTIS

SAP: HC A22/MF A01 In Denver Research Inst. Artificial Intelligence in Maintenance p 257-273 (SEE N85-11592 02-63)

CIO: UNITED STATES

MAJS: /*ARTIFICIAL INTELLIGENCE/ *AVAILABILITY/ *COMPUTER TECHNIQUES/ *DIAGNOSIS/ *ELECTRONIC EQUIPMENT/ *EXPERT SYSTEMS/ *FAULT TOLERANCE/ *INTEGRITY/ *MAINTAINABILITY/ *SYSTEM FAILURES/ *SYSTEMS ANALYSIS

MINS: /APPROACH/ PROBLEM SOLVING/ RELIABILITY

ABA: Author (GRA)

ABS: This paper introduces the concept of artificial intelligence-based (expert) systems for enhancing system availability through system integrity monitoring and system diagnosis. Such expert systems use knowledge and inference mechanisms to solve problems which would ordinarily require the expertise of the best human practitioners in the field. The paper demonstrates the seriousness of failure and explains why several traditional methods of ensuring system availability, reliability, and maintainability fail in certain important cases, e.g., intermittent failures. An outline of the human diagnostic problem-solving process is presented with a computational analog. A symptom-based expert diagnostic system(*) is introduced with its early and successful results in fault prediction.

....

85N11590# ISSUE 2 PAGE 244 CATEGORY 62 RPT#: AD-A145640 AFOSR-84-0841TR CNT#: AF-AFOSR-0217-80 83/09/00 12 PAGES UNCLASSIFIED DOCUMENT

UTTL: Fault tolerant computing research TLSP: Final Report, 1 Jul. 1980 - 30 Jun. 1983

AUTH: A/PRADHAN, D. K.

CORP: Oakland Univ., Rochester, Mich. CSS: (School of Engineering.) AVAIL.NTIS

SAP: HC A02/MF A01

CIO: UNITED STATES

MAJS: /*ARCHITECTURE (COMPUTERS)/ *COMPUTER NETWORKS/ *FAULT TOLERANCE/ * MULTIPROCESSING (COMPUTERS)/ *READ-ONLY MEMORY DEVICES

MINS: /COMPUTER TECHNIQUES/ DISTRIBUTED PROCESSING/ ELECTRIC CONNECTORS/ ERROR CORRECTING CODES

ABA: GRA

ABS: During this reporting period, three main topics were investigated: (1) Design of fault tolerant computers using read-only memories as basic building blocks; (2) Design of programmable logic arrays and sequential networks for testability; and (3) Design of fault tolerant multiprocessor network architectures. Some titles of the resulting papers are: Sequential network design using extra inputs for fault detection; A class of unidirectional error correcting codes; A uniform representation of permutation networks used in memory processor interconnections; and A fault tolerant communication architecture for distributed systems.

....

85N10711*# ISSUE 1 PAGE 106 CATEGORY 62 RPT#: NASA-TM-86304 NAS 1.15:86304 84/09/00 51 PAGES UNCLASSIFIED DOCUMENT

UTTL: Communications protocols for a fault tolerant, integrated local area network for Space Station applications

AUTH: A/MEREDITH, B. D.

CORP: National Aeronautics and Space Administration. Langley Research Center, Hampton, Va. AVAIL.NTIS

SAP: HC A04/MF A01

CIO: UNITED STATES

MAJS: /*COMMUNICATION NETWORKS/ *FAULT TOLERANCE/ *NETWORK CONTROL/ *SPACE STATIONS / *SPACECRAFT COMMUNICATION

MINS: /ALGORITHMS/ LOCAL AREA NETWORKS/ MAINTENANCE/ SYSTEMS INTEGRATION/ VOICE COMMUNICATION

ABA: Author

ABS: The evolutionary growth of the Space Station and the diverse activities onboard are expected to require a hierarchy of integrated,local area networks capable of supporting data, voice and video communications. In addition, fault tolerant network operation is necessary to protect communications between critical systems attached to the net and to relieve the valuable human resources onboard Space Station of day-to-day data system repair tasks. An experimental, local area network is being developed which will serve as a testbed for investigating candidate algorithms and technologies for a fault tolerant, integrated network. The establishment of a set of rules or protocols which govern communications on the net is essential to obtain orderly and reliable operation. A hierarchy of protocols for the experimental network is presented and procedures for data and control communications are described.

....

85A44565 ISSUE 21 PAGE 3166 CATEGORY 66 85/08/00 14 PAGES UNCLASSIFIED DOCUMENT

UTTL: Analytical failure-detection using adaptive, secondary observers

AUTH: A/SIDAR, M.

PAA: A/(Rafael Armament Development Authority, Haifa, Israel)

CIO: ISRAEL; Journal of Optimization Theory and Applications (ISSN 0022-3239), vol. 46, Aug. 1985, p. 591-604.

MAJS: /*ADAPTIVE CONTROL/ *CONTROL SYSTEMS DESIGN/ *FAULT TOLERANCE/ *OBSERVABILITY (SYSTEMS)

MINS: /CONTROL STABILITY/ CONVERGENCE/ MATRICES (MATHEMATICS)/ SYSTEMS SIMULATION

ABA: Author

ABS: The problem of designing analytical failure-detection systems, using adaptive observers, is addressed in this paper. Failure-detection systems can be applied to linear multi-input, multi-output systems and are related to the examination of the n-dimensional observer error vector which carries the necessary information on possible failures. This approach leads toward the design of highly sensitive failure detection systems, obtaining a unique fingerprint for every possible failure (abrupt or soft). In order to keep the observer's false-alarm rate under a certain specified value, it is necessary to have an acceptable matching between the observer model and the system parameters. It is shown here that properly designed adaptive observers are able to detect abrupt changes in the system (actuator, sensor failures, etc.) with adequate reliability. Conditions for convergence for the adaptive observer algorithm are obtained. Good tracking performance with small observer output errors, coupled with accurate and fast parameter identification in both deterministic and stochastic cases, is obtained.

....

85A43489 ISSUE 21 PAGE 3157 CATEGORY 60 83/10/00 12 PAGES UNCLASSIFIED DOCUMENT

UTTL: Architecture optimization of aerospace computing systems

AUTH: A/PEDAR, A.; B/SARMA, V. V. S.

PAA: A/(National Aeronautical Laboratory, Bangalore, India); B/(Indian Institute of Science, Bangalore, India)

CIO: INDIA, IEEE Transactions on Computers (ISSN 0018-9340), vol. C-32, Oct. 1983, p. 911-922.

MAJS: /*AEROSPACE SYSTEMS/ *AIRBORNE/SPACEBORNE COMPUTERS/ *ARCHITECTURE (COMPUTERS)/ *COMPUTER SYSTEMS DESIGN/ *OPTIMIZATION/ *REAL TIME OPERATION

MINS: /ALGORITHMS/ DYNAMIC PROGRAMMING/ FAULT TOLERANCE/ MODULARITY/ MULTIPROCESSING (COMPUTERS)/ RELIABILITY

ABA: Author

ABS: Simultaneous consideration of both performance and reliability issues is important in the choice of computer architectures for real-time aerospace applications. One of the requirements for such a fault-tolerant computer system is the characteristic of graceful degradation. A shared and replicated resources computing system represents such an architecture. In this paper, a combinatorial model is used for the evaluation of the instruction execution rate of a degradable, replicated resources computing system such as a modular multiprocessor system. Next, a method is presented to evaluate the computation reliability of such a system utilizing a reliability graph model and the instruction execution rate. Finally, this computation reliability measure, which simultaneously describes both performance and reliability, is applied as a constraint in an architecture optimization model for such computing systems.

....

85A34179 ISSUE 15 PAGE 2235 CATEGORY 62 RPT#: AD-A161356 AFOSR-TR-85-0934 CNT#: AF-AFOSR-84-0052 85/05/00 14 PAGES UNCLASSIFIED DOCUMENT

UTTL: Dynamically restructurable fault-tolerant processor network architectures

AUTH: A/PRADHAN, D. K.

PAA: A/(Massachusetts, University, Amherst, MA)

CIO: UNITED STATES; IEEE Transactions on Computers (ISSN 0018-9340), vol. C-34, May 1985, p. 434-447.

MAJS: /*ARCHITECTURE (COMPUTERS)/ *COMPUTER DESIGN/ *DIGITAL COMPUTERS/ *DISTRIBUTED PROCESSING/ *FAULT TOLERANCE/ *MULTIPROCESSING (COMPUTERS)

MINS: / CIRCUITS/ DISTRIBUTED PARAMETER SYSTEMS/ INPUT/OUTPUT ROUTINES/ MESSAGE PROCESSING/ NETWORK ANALYSIS/ PARALLEL PROCESSING (COMPUTERS)/ PARTITIONS (MATHEMATICS)

ABA: Author

ABS: A class of novel fault-tolerant multiprocessor networks is proposed. These networks are restructurable in that they can assume different logical configurations to suit different problem environments. More importantly, this restructuring capability is not altered even after the occurrence of faults. These networks are novel in that they uniquely combine certain desirable features, including self-routing of messages, dynamic reconfigurability, fault-tolerance, the ability to incorporate incremental extension, as well as the capacity to be partitioned with fault-tolerance. What is important about these fault-tolerant features is that they are built-in as an integral part of the design, and not as done traditionally, by means of redundancy. Also, the networks are robust with respect to all single component failures in that the network properties remain relatively intact in spite of the occurrence of a fault. Consequently, the network is not only free from single point failures, but can provide for grace degradation - an important consideration in any fault-tolerant design.

....

85A25108 ISSUE 10 PAGE 1446 CATEGORY 60 84/10/00 4 PAGES UNCLASSIFIED DOCUMENT

UTTL: Performance/reliability measures for fault-tolerant computing systems

AUTH: A/OSAKI, S.

PAA: A/(Hiroshima University, Higashi-Hiroshima, Japan)

CIO: JAPAN; IEEE Transactions on Reliability (ISSN 0018-9529), vol. R-33, Oct. 1984, p. 268-271.

MAJS: /*COMPUTER SYSTEMS PERFORMANCE/ *FAULT TOLERANCE/ *RELIABILITY ANALYSIS

MINS: /HARDWARE/ MTBF/ STEADY STATE/ THRESHOLDS

ABA: Author

ABS: Some fault-tolerant computing systems are discussed and existing reliability measures are explained. Some performance/reliability measures are introduced. Several systems are compared by using numerical examples with the new measures.

....

85A24795*# ISSUE 10 PAGE 1347 CATEGORY 18 85/02/00 4 PAGES UNCLASSIFIED DOCUMENT

UTTL: Expanding role for autonomy in military space

AUTH: A/EVANS, D. D.; B/GAJEWSKI, R. R.

PAA: A/(California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA); B/(USAF, Space Technology Center, Kirtland AFB, NM)

CORP: Jet Propulsion Lab., California Inst. of Tech., Pasadena.; Air Force Space Technology Center, Kirtland AFB, N. Mexico.

CIO: UNITED STATES; Aerospace America (ISSN 0740-722X), vol. 23, Feb. 1985, p. 74-77.

MAJS: /*AUTONOMY/ *MILITARY SPACECRAFT

MINS: /AIRBORNE/SPACEBORNE COMPUTERS/ ARTIFICIAL INTELLIGENCE/ EXPERT SYSTEMS/ FAULT TOLERANCE/ ONBOARD DATA PROCESSING

ABA: M.S.K.

ABS: The Jet Propulsion Laboratory is currently transferring satellite on-board autonomy technology to the USAF for use in military spacecraft as a means of lowering the ground support requirements. The techniques were proven on the Viking and Voyager spacecraft and permitted on-board fault detection and correction. New military

satellites will incorporate an autonomous redundancy and maintenance management subsystem in an on-board computer, while the system will still be subject to ground-based safing commands for situations demanding deeper analyses. A level 5 autonomy will need 256 kb memory, 10 Mb nonvolatile data storage and 50 W power and will weigh 20 kg. Systems will be periodically checked and compared with an ideal in the data base. Deviations detected will result in a rollback and redundant examination by two microprocessors, which can initiate correction commands until operational criteria are met. The development of the expert systems to the point that they satisfy military specifications is expected to take 10 yr.

....

85A17876# ISSUE 6 PAGE 686 CATEGORY 4 RPT#: AIAA PAPER 84-2708 84/00/00 5 PAGES UNCLASSIFIED DOCUMENT

UTTL: Avionics hardware design for testability

AUTH: A/FERRELL, B. L.; B/OVER, S. L.

PAA: B/(General Dynamics Corp., Fort Worth, TX)

CIO: UNITED STATES

IN: Digital Avionics Systems Conference, 6th, Baltimore, MD, December 3-6, 1984, Proceedings (A85-17801 06-01). New York, American Institute of Aeronautics and Astronautics, 1984, p. 498-502.

MAJS: /*AVIONICS/ *ELECTRONIC EQUIPMENT TESTS/ *FAILURE ANALYSIS/ *FAULT TOLERANCE / *HARDWARE/ *RELIABILITY ENGINEERING

MINS: /AUTOMATIC TEST EQUIPMENT/ CHIPS (ELECTRONICS)/ COST EFFECTIVENESS/ INTEGRATED CIRCUITS/ ONBOARD DATA PROCESSING/ RELIABILITY ANALYSIS/ SELF TESTS/ SYSTEMS ENGINEERING

ABA: T.K.

ABS: Design strategies to improve the onboard testability of avionics hardware are discussed in the light of the ongoing trend toward higher degrees of integration in electronic equipment. Current problems in fault detection and isolation are reviewed; the time limitations of manual or software-resident test routines are indicated; and the need for integrated-circuit-level continuous or semicontinuous self-testing for the components of the 1990s is stressed. An overall test strategy employing a hierarchic arrangement of on-chip self-tests, module-test controllers, subsystem-test controllers, and a fault-management system is recommended.

....

85A17344 ISSUE 5 PAGE 634 CATEGORY 60 CNT#: NSF MCS-83-07026 84/12/00 14 PAGES UNCLASSIFIED DOCUMENT

UTTL: Fault-tolerant computing - Concepts and examples

AUTH: A/RENNELS, D. A.

PAA: A/(California, University, Los Angeles, CA)

CIO: UNITED STATES; IEEE Transactions on Computers (ISSN 0018-9340), vol. C-33, Dec. 1984, p. 1116-1129.

MAJS: /*ARCHITECTURE (COMPUTERS)/ *COMPUTER DESIGN/ *COMPUTER SYSTEMS DESIGN/ *FAULT TOLERANCE

MINS: / AIRBORNE/ SPACEBORNE COMPUTERS/ COMPUTER COMPONENTS/ COMPUTER NETWORKS/ ERROR DETECTION CODES/ HIERARCHIES/ REDUNDANT COMPONENTS

ABA: Author

ABS: This paper presents a brief history of fault-tolerant computing. This is followed by a survey of architectural approaches to fault-tolerant design, emphasizing the basic concepts employed in the design of these systems, and the tradeoffs and alternatives available to the system designer in attempting to meet applications requirements. Classes of fault-tolerance applications are identified, along with design approaches which are applicable, and several problem areas are identified in which new research results are badly needed.

....

84K10537 (MOD-000) CNT#: NCA2-251301 DUN#: 991646068 CIC#: 1379510 National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif. California State Univ., Fresno.

UTTL: Design of fault-tolerant systems using performance monitors UNCLASSIFIED SEPTEMBER 1, 1983 / MAY 31, 1984

TM: A/LIM, R. S. A/233-14

PI: B/HEANEY, A. A. REPORT STATUS UNAVAILABLE - Incomplete processing

MAJS: /*COMPUTER SYSTEMS DESIGN/ *COMPUTER SYSTEMS PERFORMANCE/ *FAULT TOLERANCE

....

84A41699 ISSUE 20 PAGE 2936 CATEGORY 60 CNT#: SRC-B/53981 SRC-B/70667 84/07/00 6 PAGES UNCLASSIFIED DOCUMENT

UTTL: A review of synchronization and matching in fault-tolerant systems

AUTH: A/MOORE, W. R.; B/HAYNES, N. A.

PAA: A/(Southampton, University, Southampton, England); B/(Reliability Consultants, Ltd., Titchfield, Hants., England)

CIO: UNITED KINGDOM; IEE Proceedings, Part E - Computers and Digital Techniques (ISSN 0143-7062), vol. 127, pt. E, July 1984, p. 119-124. Sponsorship: Science and Engineering Research Council.

MAJS: /*COMPUTER SYSTEMS DESIGN/ *FAULT TOLERANCE/ *MICROPROCESSORS/ *RELIABILITY ENGINEERING/ *SYNCHRONISM/ *SYSTEM FAILURES

MINS: / ALGORITHMS/ ASYMPTOTIC METHODS/ FAILURE MODES/ INTERRUPTION/ MATCHING/ REDUNDANT COMPONENTS

ABA: Author

ABS: The paper reviews the reasons for and the problems of synchronizing the processors of a fault-tolerant system and of matching the data in them. It is known that exact solutions require at least (3t + 1) channels for T-fault-tolerance, but that more economical solutions with only (2t + 1) channels are feasible when assumptions are made which ensure consistent data in the fault-free processors. The assumptions and the efficiencies of previous algorithms are discussed in the light of overall reliability targets, and the relevance of 'malicious' faults and interactive consistency are highlighted. New minimum-hardware solutions are introduced which are particularly suited to microprocessor applications.

....

84A26771 ISSUE 11 PAGE 1506 CATEGORY 6 83/00/00 8 PAGES UNCLASSIFIED DOCUMENT

UTTL: Fault, detection, isolation, and recovery techniques for fault tolerant digital avionics

AUTH: A/HITT, E. F.; B/ELDREDGE, D.

PAA: A/(Battelle Columbus Laboratories, Columbus, OH); B/(FAA, Technical Center, Atlantic City, NJ)

CIO: UNITED STATES

IN: Digital Avionics Systems Conference, 5th, Seattle, WA, October 31-November 3, 1983, Proceedings (A84-26701 11-06). New York, Institute of Electrical and Electronics Engineers, 1983, p. 16.1.1-16.1.8.

MAJS: /*AIRBORNE/SPACEBORNE COMPUTERS/ *AVIONICS/ *COMPUTER SYSTEMS PERFORMANCE/ * DIGITAL SYSTEMS/ *ELECTRONIC EQUIPMENT TESTS/ *FAULT TOLERANCE

MINS: / CIRCUIT RELIABILITY/ FAILURE ANALYSIS/ IN-FLIGHT MONITORING/ RELIABILITY ENGINEERING/ SYSTEM FAILURES

ABA: Author

ABS: Fault tolerant design technologies for digital avionics system are described in this paper. The techniques include both hardware and software methods used for detecting faults at three levels. These levels should be implemented to assure (1) the correct operation of each processing unit, (2) valid communication of data

between digital subsystems, and (3) data validity, prior to use in subsequent computation and after conversion of digital data. Once a fault is detected, system recovery must take place to assure the continued performance of the function(s) affected by the fault. The methods used to control the system recovery techniques are dependent upon the system's ability to isolate the detected fault to the lowest possible level. The system recovery techniques are also dependent upon the system architecture. Fault isolation and system recovery techniques require knowledge of the system status vector and its history in sophisticated systems.

....

84A26768 ISSUE 11 PAGE 1506 CATEGORY 6 83/00/00 7 PAGES UNCLASSIFIED DOCUMENT

UTTL: Testing BITE on Boeing 757/767 in a simulated operational environment

AUTH: A/LEE, H. F.; B/CARSON, D. P.

PAA: B/(Boeing Co., Seattle, WA)

CIO: UNITED STATES

IN: Digital Avionics Systems Conference, 5th, Seattle, WA, October 31-November 3, 1983, Proceedings (A84-26701 11-06). New York, Institute of Electrical and Electronics Engineers, 1983, p. 15.4.1-15.4.7.

MAJS: /*AIRCRAFT CONTROL/ *AUTOMATIC TEST EQUIPMENT/ *DATA SIMULATION/ *FLIGHT CONTROL/ *GROUND TESTS/ *SYSTEMS MANAGEMENT

MINS: /BOEING 757 AIRCRAFT/ BOEING 767 AIRCRAFT/ DATA ACQUISITION/ DESIGN ANALYSIS/ ELECTRONIC AIRCRAFT/ FAULT TOLERANCE/ FLIGHT SIMULATION/ FLIGHT TESTS

ABA: Author

ABS: To provide 'on-airplane' data that supports validation of the system-level operation of 757/767 Flight Management System (FMS) built-in test equipment (BITE), a series of ground tests were conducted with simulated airplane flight and fault conditions. These tests provided qualitative support for establishing BITE credibility, and usage experience prior to airplane service introduction. BITE indications were correlated with the cockpit effects, simulated fault conditions, and simulation limitations to determine proper correlation and utility of indications. Results either indicated proper operation or improvements needed.

....

84A43946 ISSUE 21 PAGE 3101 CATEGORY 60 CNT#: NSF MCS-78-18918 NSF MCS-81-21696 84/08/00 14 PAGES UNCLASSIFIED DOCUMENT

UTTL: Fault tolerance by design diversity - Concepts and experiments

AUTH: A/AVIZIENIS, A.; B/KELLY, J. P. J.

PAA: B/(California, University, Los Angeles, CA)

CIO: UNITED STATES; Computer (ISSN 0018-9162), vol. 17, Aug. 1984, p. 67-80. Research supported by Battelle Memorial Institute and FAA.

MAJS: /*ARCHITECTURE (COMPUTERS)/ *COMPUTER SYSTEMS DESIGN/ *DISTRIBUTED PROCESSING/ *FAULT TOLERANCE/ *SOFTWARE ENGINEERING

MINS: / ERROR DETECTION CODES/ PL/1/ PROGRAMMING LANGUAGES/ SOFTWARE TOOLS/ SPECIFICATIONS

ABA: C.D.

ABS: The advantages and limitations of design diversity, an approach in which hardware and software elements that are to be used for multiple computations are not copies but rather are independently designed to meet a system's requirements, are discussed. The multiple-computation approach to fault tolerance is described, and the types of faults in multiple computations are identified. Design diversity in multiple computations is addressed, as are the elimination of related design faults and the potential advantages of design diversity. An experimental effort to determine the feasibility of adapting N-fold modular redundancy to provide fault

tolerance of software design faults is described, and the experimental results are presented, including types and causes of errors. Areas of concern and suggested improvements are addressed.

....

84A10052# ISSUE 1 PAGE 84 CATEGORY 61 RPT#: AIAA PAPER 83-2409 CNT#: DAAB07-83-K-K542 83/00/00 9 PAGES UNCLASSIFIED DOCUMENT

UTTL: Design of a fault-tolerant network operating system based on nested atomic actions

AUTH: A/LIAN, R. C.; B/LIU, M. T.

PAA: B/(Ohio State University, Columbus, OH)

CIO: UNITED STATES

IN: Computers in Aerospace Conference, 4th, Hartford, CT, October 24-26, 1983, Collection of Technical Papers (A84-10001 01-59). New York, American Institute of Aeronautics and Astronautics, 1983, p. 340-348.

MAJS: /*COMPUTER NETWORKS/ *COMPUTER SYSTEMS DESIGN/ *DISTRIBUTED PROCESSING/ * FAULT TOLERANCE

MINS: /INTERPROCESSOR COMMUNICATION

ABA: Author

ABS: The concept of using nested atomic actions as a framework for designing a reliable distributed system is gaining more and more acceptance. Various design issues in a fault-tolerant network operating system based on the cell model are investigated. A cell is a fault-tolerant server which implements the concept of nested atomic actions. Nested atomic actions are a decomposition of a computation into a tree-like structure such that each tree leaf, each subtree, and the whole tree preserve the atomic pro Using the principles of layered approach and recursive structuring, a fault-tolerant network operating system based on the cells is presented. Various design issues in naming, communication, synchronization, fault tolerance, security, conversion, and accounting are also discussed. The protocol structure is divided into three layers: interprocess communication, service support, and service layers. The abstractions of nested atomic actions and reliable virtual machines re supported in the layers. Applications can be developed on top of it.

....

84A10001 ISSUE 1 PAGE 81 CATEGORY 59 83/00/00 502 PAGES UNCLASSIFIED DOCUMENT

UTTL: Computers in Aerospace Conference, 4th, Hartford, CT, October 24-26, 1983, Collection of Technical Papers

SAP: Members, $75.; nonmembers, $85

CIO: UNITED STATES; Conference sponsored by the American Institute of Aeronautics and Astronautics. New York, American Institute of Aeronautics and Astronautics, 1983, 502 p.

MAJS: /*AIRBORNE/SPACEBORNE COMPUTERS/ *ARCHITECTURE (COMPUTERS)/ *ARTIFICIAL INTELLIGENCE/ *COMPUTER PROGRAMMING/ *COMPUTER SYSTEMS DESIGN/ *CONFERENCES

MINS: /ADA (PROGRAMMING LANGUAGE)/ COMMAND AND CONTROL/ DATA BASE MANAGEMENT SYSTEMS/ DISTRIBUTED PROCESSING/ EXPERT SYSTEMS/ FAULT TOLERANCE/ IMAGE PROCESSING/ METAL OXIDE SEMICONDUCTORS/ NASA PROGRAMS/ PARALLEL PROCESSING (COMPUTERS)/ RADIATION HARDENING/ VERY LARGE SCALE INTEGRATION

ABA: O.C.

ABS: Among the topics discussed are logic programming for intelligent data bases, fault-tolerant distributed systems employing Ada, forward recovery software fault tolerance, the NASA software management and assurance program, space station data management, highly parallel systems, artificial intelligence, software engineering procedures and standards, advanced VLSI MOS applications, and digital processing architectures for autonomous spacecraft. Also considered are the radiation hardening of a spacecraft memory system, spaceborne image processing, forecasting trends in NASA flight software development tools, an expert system for spacecraft command and control, IR astronomical imaging employing a microcomputer data system, the evolution of a source library system, an end-to-end data system for the Gamma-Ray Observatory, and sensor fusion in tactical warfare. For individual items see A84-10002 to A84-10069

....

83N36337# ISSUE 24 PAGE 3955 CATEGORY 32 RPT#: AD-A129438 RADC-TR-83-36 CNT#: F30602-81-C-0133 AF PROJ. 2338 83/02/00 81 PAGES UNCLASSIFIED DOCUMENT

UTTL: Fault tolerance, reliability and testability for distributed systems

TLSP: Interim Report, Sep. 1981 - Oct. 1982

AUTH: A/HECHT, H.; B/HECHT, M.; C/KIM, K. H.

CORP: SoHaR, Inc., Los Angeles, Calif. AVAIL.NTIS

SAP: HC A05/MF A01

CIO: UNITED STATES, Griffiss AFB, N.Y. RADC

MAJS: /*COMMAND AND CONTROL/ *COMPUTER TECHNIQUES/ *DISTRIBUTED PROCESSING/ *FAULT TOLERANCE

MINS: /DIGITAL COMPUTERS/ POSITION (LOCATION)/ RELIABILITY/ SYSTEM EFFECTIVENESS/ USER REQUIREMENTS

ABA: Author (GRA)

ABS: A growing need exists for improved fault tolerance, reliability, and testability in distributed systems which support Command, Control and Communications and Intelligence (C3I) activities. The objective of this study is to provide a foundation for the development of design measures and guidelines for the design of fault tolerant systems. Taxonomies of fault tolerance and distributed systems are developed, and typical Air Force C3I needs in both fault tolerant and distributed computer systems are characterized. Reliability and availability experience for ten typical computer systems is reported in a consistent format, and the data are analyzed from the perspective of a distributed system user. Previous work on the identification of problems in distributed systems and design methods for their solutions is discussed. Key issues in the design of fault tolerant distributed systems are identified. Fault location techniques for specific computer configurations found in C3I applications are described in detail. The study is a continuing effort, and a comprehensive design methodology will be developed based upon the material presented in this report.

....

83N13819*# ISSUE 4 PAGE 579 CATEGORY 60 RPT#: NASA-CR-169560 NAS 1.26:169560 CNT#: NAG1-296 82/08/00 54 PAGES UNCLASSIFIED DOCUMENT

UTTL: Design and evaluation of a fault-tolerant multiprocessor using hardware recovery blocks

AUTH: A/LEE, Y. H.; B/SHIN, K. G.

CORP: Michigan Univ., Ann Arbor. CSS: (Computing Research Lab.) AVAIL.NTIS

SAP: HC A04/MF A01

CIO: UNITED STATES

MAJS: /*COMPUTER DESIGN/ *COMPUTER SYSTEMS PERFORMANCE/ *FAULT TOLERANCE/ * MULTIPROCESSING (COMPUTERS)

MINS: /MATHEMATICAL MODELS/ MEAN/ RUN TIME (COMPUTERS)/ VARIANCE (STATISTICS)

ABA: M.G.

ABS: A fault-tolerant multiprocessor with a rollback recovery mechanism is discussed. The rollback mechanism is based on the hardware recovery block which is a hardware equivalent to the software recovery block. The hardware recovery block is constructed by consecutive state-save operations and several state-save units in every processor and memory module. When a fault is detected, the multiprocessor reconfigures itself to replace the faulty component and then the process originally assigned to the faulty component rereats to one of the previously saved states in order to resume fault-free execution. A mathematical model is proposed to calculate both the coverage of multi-step rollback recovery and the risk of restart. A performance evaluation in terms of task execution time is also presented.

....

83A22825* ISSUE 8 PAGE 1155 CATEGORY 62 CNT#: NAS1-15428 82/00/00 5 PAGES UNCLASSIFIED DOCUMENT

UTTL: The software-implemented fault tolerance /SIFT/ approach to fault tolerant computing

AUTH: A/GOLDBERG, J.

PAA: A/(SRI International Computer Science Laboratory, Menlo Park, CA)

CORP: SRI International Corp., Menlo Park, Calif.

CIO: UNITED STATES

In: Real-time signal processing IV; Proceedings of the Meeting, San Diego, CA, August 25-28, 1981. (A83-22794 08-60) Bellingham, WA, SPIE - The International Society for Optical Engineering, 1982, p. 289-293.

MAJS: /*AIRBORNE/ SPACEBORNE COMPUTERS/ *AUTOMATIC FLIGHT CONTROL/ *COMPUTER DESIGN / *FAULT TOLERANCE/ *RELIABILITY ENGINEERING

MINS: /AIR TRANSPORTATION/ AIRCRAFT RELIABILITY/ CHANNELS (DATA TRANSMISSION)/ COMPUTER PROGRAMS/ FAIL-SAFE SYSTEMS/ HIGH LEVEL LANGUAGES/ PROGRAM VERIFICATION (COMPUTERS)

ABA: C.R.

ABS: SIFT is an experimental computer designed for highly reliable flight-control service in advanced air transports. Its development was intended to integrate and demonstrate the latest techniques in fault-tolerant computing. During its development, several new problems of some generality were uncovered and solved. The technology developed for the validation of its design is seen as being perhaps as important as the design itself. The SIFT design is described, as is the way in which the design and its validation were shaped by the requirements of its intended application. Attention is also given to reliability and fault tolerance. The most significant feature of the hardware design is the absence of elements that can generate multiple faults, such as shared clocks or data buses. It is noted that the software is realized in only 800 lines of code, of which 80% are in a high-level language.

....

82A14714# ISSUE 4 PAGE 592 CATEGORY 61 81/00/00 10 PAGES UNCLASSIFIED DOCUMENT

UTTL: Fault secure avionic system development

AUTH: A/JENNINGS, R.

PAA: A/(USAF, Wright Aeronautical Laboratories, Wright-Patterson AFB, OH)

CIO: UNITED STATES

In: NAECON 1981; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 19-21, 1981. Volume 1. (A82-14676 04-01) New York, Institute of Electrical and Electronics Engineers, Inc., 1981, p. 284-293.

MAJS: /*AIRBORNE/ SPACEBORNE COMPUTERS/ *AVIONICS/ *CIRCUIT RELIABILITY/ *COMPUTER DESIGN/ *FAIL-SAFE SYSTEMS/ *FAULT TOLERANCE

MINS: /ARCHITECTURE (COMPUTERS)/ DATA MANAGEMENT/ FAIL-SAFE SYSTEMS/ RELIABILITY ENGINEERING/ SYSTEMS ENGINEERING

ABA: C.R.

ABS: With the technological improvements that have been made in computer hardware, major limitations now have to do with programmability, integrity, and reliability. It is contended that these limitations can be largely solved at the computer and integrated circuit architecture level through an organizational concept called Fault Secure Avionic Computer (FSAC). The kernel of the FSAC consists of a programmable processor, of a type suitable for mass production, which has provisions for exploiting special purpose VLSI arithmetic and data management hardware to expedite execution of time critical tasks.

....

82A13490*# ISSUE 3 PAGE 425 CATEGORY 60 RPT#: AIAA 81-2278 CNT#: NAS1-15428 81/00/00 5 PAGES UNCLASSIFIED DOCUMENT

UTTL: The SIFT computer and its development — Software Implemented Fault Tolerance for aircraft control

AUTH: A/GOLDBERG, J.

PAA: A/(SRI International, Menlo Park, CA)

CORP: SRI International Corp., Menlo Park, Calif.

CIO: UNITED STATES

In: Digital Avionics Systems Conference, 4th, St. Louis, MO, November 17-19, 1981, Collection of Technical Papers. (A82-13451 03-04) New York, American Institute of Aeronautics and Astronautics, 1981, p. 285-289.

MAJS: /*AIRBORNE/SPACEBORNE COMPUTERS/ *COMPUTER DESIGN/ *COMPUTER PROGRAMS/ * FAIL-SAFE SYSTEMS/ *FAULT TOLERANCE/ *RELIABILITY ENGINEERING

MINS: /AIRCRAFT RELIABILITY/ ARCHITECTURE (COMPUTERS)/ COMPUTER NETWORKS/ COMPUTER SYSTEMS DESIGN/ MARKOV PROCESSES/ MATHEMATICAL MODELS/ MULTIPROCESSING (COMPUTERS)/ SYSTEMS ENGINEERING

ABA: S.C.S.

ABS: Software Implemented Fault Tolerance (SIFT) is an aircraft control computer designed to allow failure probability of less than 10 to the -10th/hour. The system is based on advanced fault-tolerance computing and validation methodology . Since confirmation of reliability by observation is essentially impossible, system reliability is estimated by a Markov model. A mathematical proof is used to justify the validity of the Markov model. System design is represented by a hierarchy of abstract models, and the design proof comprises mathematical proofs that each model is, in fact, an elaboration of the next more abstract model.

....

No: A3 **Title:** Autonomous GN&C

Operations Requirement:

Eliminate vehicle dependence on GN&C GSE for test and checkout.

Rationale:

Onboard BIT/BITE and Vehicle Health Monitoring System (VHMS) for GN&C can eliminate/simplify/speed-up ground operations.

Sample Concept:

Boeing 757/767 or advanced military aircraft computerized electronics providing self-test and fault identification with fault-tolerant computers. Ability to replace circuit boards without system shutdown. Easy accessibility. See A1, A2.

Technology Requirement:

Further development of BIT/BITE and VHMS.

Technology References:

NASA/RECON: 87N16551, 87N11735, 87A33249, 87A32117, 87A19603, 86X75348, 86K10299, 86A28490, 85X74761, 85X73876, 85N22229, 85A45971, 85A41019, 85A39562, 85A24795, 84X77582, 84X72233, 84X10357, 84N72750, 84N24603, 84N12237, 84K10744, 84K10153, 84A43401, 84A40143, 84A29544, 84A29543, 84A26701, 84A16526, 84A11999, 83A11175

87N16551# ISSUE 8 PAGE 1092 CATEGORY 63 RPT#: AD-A174250 86/06/00 129 UNPAGES CLASSIFIED DOCUMENT

UTTL: An introduction to artificial intelligence and its potential use in space systems

TSP: M.S. Thesis

AUTH: A/MCDONALD, GARY W.

CORP: Naval Postgraduate School, Monterey, Calif.

AP: Avail: NTIS HC A07/MF A01

CIO: UNITED STATES

MAJS: / *AEROSPACE SYSTEMS/ ARTIFICIAL INTELLIGENCE/ *COMPUTER VISION/ *DATA PROCESSING/ *PATTERN RECOGNITION/ *ROBOTICS

MINS: / AEROSPACE ENGINEERING/ AUTOMATIC CONTROL/ GROUND STATIONS/ NATURAL LANGUAGE (COMPUTERS)/ SPACE COMMUNICATION/ SPACE MISSIONS/ SYSTEMS INTEGRATION

ABA: GRA

ABS: This survey of Artificial Intelligence (AI) is based upon a review of it history, its philosophical development, and subcategories of its current technologies. These subcategories are expert systems, natural language processing, computer vision and pattern recognition, and robotics and autonomous vehicles. Emphasis is then directed toward the description of the fundamental characteristics of a generic space system, including the space bus components, mission system components, ground node functions, and system missions. It is concluded tat AI, in site of its immaturity as a science, will prove to be a beneficial component of future space systems.

....

87N11735*# ISSUE 3 PAGE 306 CATEGORY 61 84/00/00 11 PAGES UNCLASSIFIED DOCUMENT

UTTL: A nonlinear programming method for system design with results that have been implemented

AUTH: A/HAUSER, F.

CORP: Boeing Aerospace Co., Seattle, Wash.

SAP: Avail: NTIS HC A22/MF A01 In NASA. Langley Research Center Recent Experiences in Multidisciplinary Analysis and Optimization, Part 1, 11 p (SEE N87-11717 03-05)

CIO: UNITED STATES

MAJS: / *COMPUTER AIDED DESIGN/ *COMPUTER PROGRAMS/ *DESIGN ANALYSIS/ *OPTIMIZATION / *STRUCTURAL DESIGN/ *SYSTEMS ENGINEERING

MINS: / AUTOMATIC PILOTS/ ICEBERGS/ PROPULSION/ REENTRY VEHICLES/ SPACE SHUTTLES / SURFACE EFFECT SHIPS

ABA: R.J.F.

ABS: A general nonlinear programming algorithm (NICO) is discussed. An academic optimization example is given. The NICO multi-input, multi-output control system design is discussed. NICO applications relative to launch vehicle autopilot design, space shuttle static balance, transient response criteria in the design of a reentry vehicle control system, and waterjet propulsion and lift system components sized to a large surface effect ship are noted.

....

87A33249 ISSUE 13 PAGE 2046 CATEGORY 63 86/00/00 480 PAGES UNCLASSIFIED DOCUMENT

UTTL: Adaptive methods for control system design -- Book

AUTH: A/GUPTA, MADAN M.; B/CHEN, CHI-HAU PAA: A/(Saskatchewan, University, Saskatoon, Canada); B/(Southeastern

Massachusetts University, North Dartmouth, MA) PAT: A/ED.; B/ED.

SAP: Members, $44.95; nonmembers, $59.95

CIO: CANADA; New York, IEEE Press, 1986, 480 p. No individual items are abstracted in this volume.

MAJS: / *ADAPTIVE CONTROL/ *CONTROL SYSTEMS DESIGN/ *OPTIMAL CONTROL

MINS: /AIRCRAFT CONTROL/ ALGORITHMS/ AUTOMATIC PILOTS/ LIAPUNOV FUNCTIONS/ LINEAR SYSTEMS/ MATRICES (MATHEMATICS)/ MODEL REFERENCE ADAPTIVE CONTROL/ NOISE MEASUREMENT/ PROCESS CONTROL (INDUSTRY)/ RANDOM NOISE/ REGULATORS/ ROBOTICS/ ROBOTS/ SELF ADAPTIVE CONTROL SYSTEMS/ STOCHASTIC PROCESSES

AB: C.D.

ABS: A collection of reprint papers is presented which covers the adaptive methods in feedback control systems that have been developed over the past two decades. Historical perspectives and surveys on adaptive control are given, and the theory for the design of model reference adaptive systems and self-tuning regulators is discussed. Adaptive control of uncertain plants using dual control and related approaches is covered. The applications to aircraft control problems, adaptive autopilots, and process control, robotics and other fields readdressed.

....[

87A32117 ISSUE 13 PAGE 2044 CATEGORY 63 87/02/00 6 PAGES UNCLASSIFIED DOCUMENT

UTTL: Control operations in advanced aerospace systems

AUTH: A/GRAHAM, WILLIAM R. PAA: A/(R&D Associates, Marina Del Rey, CA)

CIO: UNITED STATES; (IFAC, Symposium on Control of Distributed Parameter Systems, Los Angeles, CA, June 30-July 2, 1986) IEEE Control Systems Magazine (ISSN 0272-1708), vol. 7, Feb. 1987, p. 3-8.

MAJS: / *AEROSPACE SYSTEMS/ *AIRCRAFT CONTROL/ *AUTOMATIC CONTROL/ *CONTROL CONFIGURED VEHICLES/ *DISTRIBUTED PARAMETER SYSTEMS/ *LARGE SPACE STRUCTURES

MINS: /AIR BREATHING ENGINES/ ALPHA JET AIRCRAFT/ CONTROL SYSTEMS DESIGN/ EXTRAVEHICULAR ACTIVITY/ GEOLOGICAL SURVEYS/ HUBBLE SPACE TELESCOPE/ NASA SPACE PROGRAMS/ ROBOTICS

ABA: M.S.K.

ABS: Distributed parameter control systems being studied by NASA for use in advanced aerospace systems are described. A 15 m diameter antenna that will be deployed in space from a 2 cu. m box has 96 control cables for controlling the shape of the antenna. Appropriate near and far-field tests are needed for tuning the shape of the antenna on-orbit. The Space Station will be dynamically stabilized, damped and pointed with a high degree of accuracy, performed to a high degree by automated systems that adapt to a growing structure. Self-diagnosis is also a necessary feature of future EVA equipment and telerobotics, the latter assuming greater importance in a Rover for exploring the surface of Mars. The concepts are being implemented in the X-29 forward swept wing aircraft, the electronics of the Hubble Space Telescope, and in studies of the national aerospaceplane.

....

87A19603* ISSUE 6 PAGE 741 CATEGORY 18 86/00/00 400 PAGES UNCLASSIFIED DOCUMENT

UTTL: Artificial intelligence for Space Station automation: Crew safety, productivity, autonomy, augmented capability — Book

AUTH: A/FIRSCHEIN, O.; B/GEORGEFF, M. P.; C/PARK, W.; D/CHEESEMAN, P. C.; E/GOLDBERG, J. PAA: E/(NASA, Advanced Technology Advisory Committee, Houston, TX; SRI International, Menlo Park, CA)

CORP: National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.; SRI International Corp., Menlo Park, Calif.

SAP: $48

CIO: UNITED STATES; Research sponsored by NASA. Park Ridge, NJ, Noyes Publications, 1986, 400 p.

MAJS: / *ARTIFICIAL INTELLIGENCE/ *AUTOMATIC CONTROL/ *SPACE STATIONS/ *TECHNOLOGY ASSESSMENT

MINS: /AEROSPACE TECHNOLOGY TRANSFER/ EXPERT SYSTEMS/ INFORMATION SYSTEMS/ MAN MACHINE SYSTEMS/ MEMORY (COMPUTERS)/ NASA SPACE PROGRAMS/ RESEARCH AND DEVELOPMENT/ ROBOTICS/ SPACE COMMERCIALIZATION/ TELEOPERATORS

ABA: K.K.

ABS: Artificial intelligence (AI) R&D projects for the successful and efficient operation of the Space Station are described. The book explores the most advanced AI-based technologies, reviews the results of concept design studies to determine required AI capabilities, details demonstrations that could indicate the existence of these capabilities, and develops an R&D plan leading to such demonstrations. Particular attention is given to teleoperation and robotics, sensors, expert systems, computers, planning, and man-machine interface.
....

86X75348# CATEGORY 19 RPT#: AD-B099257L TR-0086(6460-02)-1 SD-TR-85-66 CNT#: F04701-85-C-0086 86/02/04 21 PAGES UNCLASSIFIED DOCUMENT US GOV AGENCIES

UTTL: Integrated launch vehicle and spacecraft avionics: A feasible option

TLSP: Final Report

AUTH: A/GILCHRIST, J. D.

CORP: Aerospace Corp., El Segundo, Calif. CSS: (Guidance and Control Div.) MFC: CO

CIO: UNITED STATES

MAJS: / *ACCELERATION (PHYSICS)/ *AUTOMATIC CONTROL/ *AVIONICS/ *INERTIAL GUIDANCE/ * LAUNCH VEHICLES/ *NAVIGATION/ *SPACECRAFT COMPONENTS/ *SPACECRAFT CONTROL/ * SPACECRAFT GUIDANCE

MINS: /COMMAND GUIDANCE/ FEASIBILITY ANALYSES/ OPTIONS/ REQUIREMENTS
....

86K10299 (Mod-004) CNT#: NAS3-24627 DUN#: 7 0014479

CIC#: 2470508 505-40-1A National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio. Pratt and Whitney Aircraft, West Palm Beach, Fla.

UTTL: Fiber Optic Control System Integration (FOCSI) phase 1 propulsion flight control design study UNCLASSIFIED - SEPTEMBER 5, 1985 / SEPTEMBER 4, 1986

TM: A/BAUMBICK, B. A/77-1

PI: B/MILLER, J. C. REPORTS EXPECTED

MAJS: / *AIRBORNE/SPACEBORNE COMPUTERS/ *AIRCRAFT CONTROL/ *AUTOMATIC CONTROL/ * CHANNELS (DATA TRANSMISSION)/ *DESIGN ANALYSIS/ *FIBER OPTICS/ *FIGHTER AIRCRAFT/ *FLIGHT CONTROL/ *PROPULSION/ *PROPULSION SYSTEM PERFORMANCE/ * SYSTEMS ENGINEERING
....

86A28490* ISSUE 12 PAGE 1651 CATEGORY 8 CNT#: NAG1-288 CUT OFF 1 LINE AGRECALL AIN FROM ORIG. VSN.

UTTL: An expert planner for the dynamic flight environment

AUTH: A/CHEN, D. C. PAA: A/(E-Systems, Inc., Garland Div., Dallas, TX)

CORP: E-Systems, Inc., Dallas, Tex.

CIO: UNITED STATES; IN: NAECON 1985; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 20-24, 1985. Volume 2 (A86-28326 12-04). New York, Institute of Electrical and Electronics Engineers, 1985, p. 1347-1354.

MAJS: / *AUTOMATIC PILOTS/ *COMPUTERIZED SIMULATION/ *EXPERT SYSTEMS/ *FLIGHT PATHS / *FLIGHT PLANS/ *ROBOTS

MINS: /AIRCRAFT ACCIDENTS/ AIRCRAFT HAZARDS/ TRAJECTORY CONTROL

ABA: Author

ABS: This paper presents a robust robot planner that functions in the complex and dynamic flight domain. The robot pilot flies an aircraft between two airports and can adjust in flight to changes in the environment such as closed destination airport, thunderstorm in the flight path, and failed engine. The planner adjusts to the world changes by locally patching around the break point instead of complete replanning. The planning architecture is based on the vertical decomposition of domain knowledge, resulting in shallow planning and recovery planning. This robot flight planner can be utilized as the front end of an intelligent flight monitor. The flight planner dynamically generates the references that are used to determine whether the flight crew should be notified of potential problems. The implementation of this robot planner is also discussed.

....

85X74761 CATEGORY 60 RPT#: JPRS-UCC-85-008-L 85/04/03 156 PAGES UNCLASSIFIED DOCUMENT US GOV AGENCIES

UTTL: USSR report: Cybernetics, computers and automation technology

CORP: Joint Publications Research Service, Arlington, Va.

CIO: U.S.S.R. Transl. into ENGLISH from various Russian articles

MAJS: / *AUTOMATIC CONTROL/ *COMPUTATION/ *COMPUTER TECHNIQUES/ *CYBERNETICS/ *DATA BASE MANAGEMENT SYSTEMS/ *INFORMATION THEORY

MINS: /ADAPTIVE CONTROL/ AUTOMATA THEORY/ COMPUTER PROGRAMMING/ COMPUTER SYSTEMS DESIGN/ DATA PROCESSING/ DESIGN/ MICROCOMPUTERS/ OPTIMIZATION/ PROGRAMMING LANGUAGES

....

85X73876# CATEGORY 20 RPT#: AD-B089454L AFWAL-TR-84-3050 CNT#: F33615-83-C-3401 84/08/30 221 PAGES UNCLASSIFIED DOCUMENT US GOV AGENCIES AND CONTRACTORS

UTTL: Selectable thrust rocket/attitude control TLSP: Final Report, Jan. 1983 - Jan. 1984

AUTH: A/SARGENT, W. H.; B/ANDERSON, C.; C/HIBBELL, M.; D/SMEDLEY, K.

CORP: Atlantic Research Corp., Gainesville, Va.

CIO: UNITED STATES; Wright-Patterson AFB, Ohio Air Force Wright Aeronautical Labs.

MAJS: / *AERODYNAMIC CHARACTERISTICS/ *ATTITUDE CONTROL/ *AVOIDANCE/ *DYNAMIC PRESSURE/ *EJECTION SEATS/ *ESCAPE SYSTEMS/ *HIGH ALTITUDE/ *HIGH PRESSURE/ * HIGH SPEED/ *JET CONTROL/ *THRUST CONTROL

MINS: /DECELERATION/DRAG CHUTES/ FLIGHT PATHS/ GAS FLOW/GAS GENERATORS/ HIGH TEMPERATURE GASES/ LOW SPEED/MANIFOLDS/ PROPULSION/ ROCKET ENGINES/ TAIL ASSEMBLIES

....

85N22229*# ISSUE 12 PAGE 1947 CATEGORY 63 85/01/00 20 PAGES UNCLASSIFIED DOCUMENT

UTTL: Evaluation of expert systems

AUTH: A/MCANULTY, M. A.

CORP: Alabama Univ., Birmingham. CSS: (Dept. of Computer and Information Science.) AVAIL.NTIS

SAP: HC A99/MF E03; In Alabama Univ. Res. Rept.: 1984 NASA/ASEE Summer Faculty Fellowship Program (NASA-CR-171317) 20p (SEE N85-22210 12-80)

CIO: UNITED STATES

MAJS: / *ALGORITHMS/ *COMPUTER PROGRAMS/ *EXPERT SYSTEMS/ *LOGIC PROGRAMMING

MINS: / ATTITUDE CONTROL/ NUMERICAL CONTROL/ SPACECRAFT ENVIRONMENTS

ABA: G.L.C.

ABS: The only successful applied area of artificial intelligence is that of expert systems, programs which collect and arrange information about the solution of difficult problems in a well-defined and well-circumscribed area, and are then capable of mimicking expert behavior in finding solutions to new problems. NASA intends to investigate the application of this technology to management and control situations in a space station environment, specifically for power, heat, communications, and attitude control, areas where much of the time human management is laborious, repetitive, and eventually error-prone.

....

85A45971# ISSUE 22 PAGE 3232 CATEGORY 9 RPT#: AIAA PAPER 85-1911 85/08/00 5 PAGES UNCLASSIFIED DOCUMENT

UTTL: The Collins AFDS Maintenance System for the Boeing 757/767 — Autopilot Flight Director System

AUTH: A/GRUETTNER, J. E.

PAA: A/(Rockwell International Corp., Cedar Rapids, IA)

CIO: UNITED STATES - AIAA, Guidance, Navigation and Control Conference, Snowmass, CO, Aug. 19-21, 1985. 5 p.

MAJS: / *AUTOMATIC FLIGHT CONTROL/ *AUTOMATIC PILOTS/ *ELECTRONIC EQUIPMENT TESTS/ * IN-FLIGHT MONITORING/ *MAINTENANCE

MINS: / BOEING 757 AIRCRAFT/ BOEING 767 AIRCRAFT/ ERROR DETECTION CODES/ GROUND TESTS/ SELF TESTS

ABA: Author

ABS: The AFDS maintenance provides a flight line maintenance capability for fault detection and fault isolation. A capability is provided for squawk related testing of a Line Replaceable Unit (LRU). These tests verify operation of the LRU and the establishment of interfaces to that LRU. The Maintenance System contains a self test capability. The Maintenance Control and Display Panel (MCDP) is the centralized maintenance computer located in the equipment bay. The MCDP contains buttons to initiate tests and respond to simple questions and contains a display efficient for communicating abbreviated English language messages. In flight, only faults known to create a Flight Deck Effect are reported. Each of the flight computers provide fault reporting and ground test capability. They provide maintenance data to the MCDP via ARINC 429 Buses.

....

85A41019# ISSUE 19 PAGE 2756 CATEGORY 8 84/00/00 11 PAGES; In JAPANESE; UNCLASSIFIED DOCUMENT

UTTL: Optical technology for flight control systems

AUTH: A/MAYANAGI, M.

CIO: JAPAN; Japan Society for Aeronautical and Space Sciences, Journal (ISSN 0021-4663), vol. 32, no. 369, 1984, p. 583-593. In Japanese.

MAJS: / *AUTOMATIC FLIGHT CONTROL/ *CONTROL SYSTEMS DESIGN/ *ONBOARD DATA PROCESSING/ *OPTICAL EQUIPMENT/ *STABILITY AUGMENTATION/ *TECHNOLOGY ASSESSMENT

MINS: /ACTIVE CONTROL/CONTROL CONFIGURED VEHICLES/DIGITAL TRANSDUCERS/ FIBER OPTICS/ OPTICAL DATA PROCESSING

ABA: S.H.

ABS: Optical applications to the flight control system including optical data bus, sensors, and transducers are analyzed. Examples of optical data bus include airborne light optical fiber technology (ALOFT), F-5E, YC-14, YA-7D, MIL-STD-1553 fiber optic data bus, and NAL-optic data bus. This NAL (National Aerospace Laboratory)-optic data bus (based on the MIL-STD-1553B) is applied to STOL, and its characteristics are stressed. Principles and advantages of optical pulse-digital transducers are discussed.

....

85A39562# ISSUE 18 PAGE 2625 CATEGORY 8 85/08/00 10 PAGES UNCLASSIFIED DOCUMENT

UTTL: Robust missile autopilot design using a generalized singular optimal control technique

AUTH: A/LIN, C.-F.; B/LEE, S. P. PAA: A/(Boeing Co., Seattle, WA); B/(Litton Industries, Woodland Hills, CA)

CIO: UNITED STATES; (Guidance and Control Conference, Seattle, WA, August 20-22, 1984, Technical Papers, p. 124-132) Journal of Guidance, Control, and Dynamics (ISSN 0731-5090), vol. 8, July-Aug. 1985, p. 498-507. Previously cited in issue 21, p. 2998, Accession no. A84-43414.

MAJS: / *AUTOMATIC PILOTS/ *MISSILE CONTROL/ *MISSILE TRAJECTORIES/ *OPTIMAL CONTROL / *RADAR HOMING MISSILES/ *TRACKING (POSITION)/ *TRAJECTORY OPTIMIZATION

MINS: / ADAPTIVE CONTROL/ ATTITUDE STABILITY/ CONTROL SYSTEMS DESIGN/ FEEDBACK CONTROL/ FEED FORWARD CONTROL/ ROBUSTNESS (MATHEMATICS)/ TERMINAL GUIDANCE/ TURNING FLIGHT

....

85A24795*# ISSUE 10 PAGE 1347 CATEGORY 18 85/02/00 4 PAGES UNCLASSIFIED DOCUMENT

UTTL: Expanding role for autonomy in military space

AUTH: A/EVANS, D. D.; B/GAJEWSKI, R. R.

PAA: A/(California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA); B/(USAF, Space Technology Center, Kirtland AFB, NM)

CORP: Jet Propulsion Lab., California Inst. of Tech., Pasadena.; Air Force Space Technology Center, Kirtland AFB, N. Mexico.

CIO: UNITED STATES; Aerospace America (ISSN 0740-722X), vol. 23, Feb. 1985, p. 74-77.

MAJS: /*AUTONOMY/ *MILITARY SPACECRAFT

MINS: /AIRBORNE/SPACEBORNE COMPUTERS/ ARTIFICIAL INTELLIGENCE/ EXPERT SYSTEMS/ FAULT TOLERANCE/ ONBOARD DATA PROCESSING

ABA: M.S.K.

ABS: The Jet Propulsion Laboratory is currently transferring satellite on-board autonomy technology to the USAF for use in military spacecraft as a means of lowering the ground support requirements. The techniques were proven on the Viking and Voyager spacecraft and permitted on-board fault detection and correction. New military satellites will incorporate an autonomous redundancy and maintenance management subsystem in an on-board computer, while the system will still be subject to ground-based safing commands for situations demanding deeper analyses. A level 5 autonomy will need 256 kb memory, 10 Mb nonvolatile data storage and 50 W power and will weigh 20 kg. Systems will be periodically checked and compared with an ideal in the data base. Deviations detected will result in a rollback and redundant examination by two microprocessors, which can initiate correction commands until operational criteria are met. The development of the expert systems to the point that they satisfy military specifications is expected to take 10 yr.

....

84X77582# CATEGORY 18 RPT#: AD-B082683L GDC-ASP-83-008-VOL-2 AFWAL-TR-83-3076-VOL-2 CNT#: F33615-81-C-3019 83/07/00 2 VOLS 485 PAGES UNCLASSIFIED DOCUMENT US GOV AGENCIES

UTTL: Advanced Military Spaceflight Capability (AMSC) technology identification study, volume 2

TLSP: Final Report, Aug. 1981 - Mar. 1983

AUTH: A/HEALD, D. A.; B/ANDERSON, D. A.; C/BOWMAN, M. D.; D/BROWER, D. L.; E/IRONS, R. E.

CORP: General Dynamics Corp., San Diego, Calif. CSS: (Convair Div.)

CIO: UNITED STATES; Wright-Patterson AFB, Ohio AFWAL

MAJS: / *AERODYNAMIC CONFIGURATIONS/ *LAUNCH VEHICLES/ *LAUNCHING/ *MILITARY SPACECRAFT/ *PROPULSION/ *REENTRY VEHICLES/ *ROCKET ENGINES/ *SINGLE STAGE TO ORBIT VEHICLES/ *SPACE FLIGHT/ *SYSTEMS ANALYSIS

MINS: /AERODYNAMIC STABILITY/ AIR LAUNCHING/ COST ANALYSIS/ CRYOGENIC FLUIDS/ LAUNCHING SITES/ MAINTAINABILITY/ RENDEZVOUS SPACECRAFT/ SPACE MISSIONS/ SPACE SHUTTLE PAYLOADS/ SPACECREWS/ TAKEOFF/ TECHNOLOGICAL FORECASTING/ VULNERABILITY

....

84X72233# CATEGORY 4 RPT#: AD-B076609L FTD-ID(RS)T-0935-83 83/08/31 207 PAGES UNCLASSIFIED DOCUMENT US GOV AGENCIES

UTTL: Navigation, guidance and control optimization

CORP: Air Force Systems Command, Wright-Patterson AFB, Ohio. CSS: (Foreign Technology Div.)

CIO: U.S.S.R. Transl. into ENGLISH from mono. "'Navigatsiya Navedeniye i Optimizatsiya Upravleniya'' Moscow, 1978 p 1-12

MAJS: / *BOOSTER ROCKET ENGINES/ *CONFERENCES/ *FLIGHT PATHS/ *NAVIGATION/ *ROCKET ENGINE CONTROL/ *SPACECRAFT GUIDANCE/ *SPACECRAFT ORBITS/ *THRUST CONTROL

MINS: /ALGORITHMS/ ATTITUDE CONTROL/CONTROL THEORY/ CONTROLLERS/ LINEAR SYSTEMS/ NAVIGATION/ OPTIMIZATION/ SOVIET SPACECRAFT/ SPACECRAFT MOTION/ SYSTEMS

....

84X10357*# ISSUE 8 CATEGORY 16 84/07/00 14 PAGES UNCLASSIFIED DOCUMENT DOMESTIC

UTTL: Concepts and technology for advanced space transportation systems

AUTH: A/GABRIS, E. A.

CORP: National Aeronautics and Space Administration, Washington, D.C.

SAP: Limited by ITAR In NASA Langley Research Center Advan. in TPS and Struct. for Space Transportation Systems p 1-14 (SEE X84-10356 08-16)

CIO: UNITED STATES

MAJS: / *AEROSPACE VEHICLES/ *LAUNCH VEHICLES/ *MISSIN PLANNING *ORBIT TRANSFER VEHICLES/ *SPACE MISSIONS/ *SPACE TRANSPORTAION SYSTEM/ *SPACECRAFT STRUCTURES

MINS: /ABLATIVE MATERIALS/ AEROBRAKING/ AEROCAPTURE/ ORBITS/ REENTRY VEHICLES/ REUSABLE SPACECRAFT/ SPACECRAFT MANEUVERS/ THERMAL PROTECTION

ABA: A.R.H.

ABS: Future requirements for Advanced Space Transportation Systems (ASTS) are assessed in terms of current NASA mission models. Concepts and technology requirements for ASTS are discussed with particular emphasis on Earth-to-orbit and orbital transfer vehicles. Mission-related technology requirements for flight configurations, flight control, aero heating, and materials and structures are emphasized. Technology drivers for the various missions are identified and key technology issues related to thermal protection systems and structural requirements are emphasized. Other issues, such as space basing of orbital transfer vehicles (OTV's), expendable or reusable transportation systems, and aero braking for OTV's, are also addressed in relation to thermal protection systems and structural requirements. Time line for technology development for the various flight configurations are included.

....

84N72750# CATEGORY 4 RPT#: PB84-116441 APO-81-1 81/07/00 164 UNPAGES CLASSIFIED DOCUMENT

ITTL: Microwave landing system transition plan

CORP: Federal Aviation Administration, Washington, D.C.

CSS: (Office of Aviation Policy and Plans.) AVAIL.NTIS

CIO: UNITED STATES

MAJS: / *COST ESTIMATES/ *INSTRUMENT LANDING SYSTEMS/ *MICROWAVE LANDING SYSTEMS/ *PUBLIC RELATIONS/ *TECHNOLOGY ASSESSMENT

MINS: /AVIONICS/ ENVIRONMENT EFFECTS/GROUND SUPPORT EQUIPMENT/ PARAMETER IDENTIFICATION/ SCHEDULES/ UPGRADING

....

84N24603# ISSUE 15 PAGE 2265 CATEGORY 12 RPT#: AGARD-CP-350 ISBN-92-835-0349-X AD-A141969 84/01/00 348 PAGES; In ENGLISH and FRENCH; UNCLASSIFIED DOCUMENT

UTTL: Guidance and Control Techniques for Advanced Space Vehicles

CORP: Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). AVAIL.NTIS

SAP: HC A15/MF A01

CIO: FRANCE; Symp. held in Florence, 27-30 Sep. 1983

MAJS: / *ACCURACY/ *ACTUATORS/ *ATTITUDE CONTROL/ *DATA PROCESSING/ *GYROSCOPES/ * NAVIGATION/ *SENSORS/ *SPACE RENDEZVOUS/ *SPACECRAFT CONTROL/ *SPACECRAFT GUIDANCE

MINS: / COMPUTER PROGRAMS/ COST ESTIMATES/ LARGE SPACE STRUCTURES/ MICROPROCESSORS/ OPTIMIZATION/ ORBITAL POSITION ESTIMATION/ ORBITAL SERVICING/ SPACECRAFT DOCKING/ SPACECRAFT MANEUVERS

ANN: This symposium dealt with spacecraft problems, the topic being guidance and control techniques for advanced space vehicles. Military applications of space for navigation, communication and intelligence impose increasing requirements on spacecraft capacity, orbit control and pointing accuracy. To meet the requirements for future spacecraft the performance of existing components, such as actuators and sensors, is improved or new concepts are developed. In particular the use of microprocessors and other data distribution systems permits multifunctional use of various sensors or information sources to produce effective, survivable systems at low cost. Increasing on-board computing capacity enables the use of sophisticated software for effective complex spacecraft control. A unique aspect of large spacecraft is the control of the structural configuration in order to achieve a specific pointing accuracy. Large structures, with their mechanical flexibility, present particular problems to the control engineer and control/structure interaction (CSI) is a driving force in many current programs and figured largely in the papers presented. For individual titles, see N84-24604 through N84-24626.

....

84N12237*# ISSUE 3 PAGE 345 CATEGORY 20 83/12/00 6 PAGES UNCLASSIFIED DOCUMENT

UTTL: Combined attitude control and energy storage

AUTH: A/HOFFMAN, H.

CORP: National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md. AVAIL.NTIS

SAP: HC A10/MF A01 In NASA. Langley Research Center Integrated Flywheel Technol., 1983 p 93-98 (SEE N84-12228 03-20)

CIO: UNITED STATES

MAJS: / *ATTITUDE CONTROL/ *ENERGY STORAGE/ *FLYWHEELS/ *SYSTEMS INTEGRATION

MINS: /FAILURE MODES/ KINETIC ENERGY/ MATRICES (MATHEMATICS)/ REDUNDANCY ENCODING/ SPIN STABILIZATION/ TORQUERS

ABA: B.G.

ABS: The effect on attitude control by multiple wheels (used for energy storage) is described.

....

84K10744 (Mod-005) CNT#: NAS1-17633 DUN#: 008383812 CIC#: 2053502 National Aeronautics and Space Administration. Langley Research Center, Hampton, Va. Rockwell International Corp., Downey, Calif.

UTTL: The applicability of composite materials technology to an attitude control and energy storage system UNCLASSIFIED JANUARY 30, 1984 / JULY 31, 1985

TM: A/WILLIAMS, J. L. A/161 REPORTS EXPECTED

MAJS: /*AERODYNAMIC DRAG/ *ATTITUDE CONTROL/ *COMPOSITE MATERIALS/ CRYOGENIC FLUIDS/ *ENERGY STORAGE/ *FLYWHEELS/ *LIFE CYCLE COSTS/ *MAGNETIC BEARINGS/ *MASS RATIOS/ *MATHEMATICAL MODELS/ *MOMENTUM/ *NICKEL HYDROGEN BATTERIES/ * RADIANT FLUX DENSITY/ *REGENERATIVE FUEL CELLS/ *SIZE (DIMENSIONS)/ *SOLAR ARRAYS/ *SPACE STATIONS/ *SPACECRAFT CONTROL/ *SPACECRAFT POWER SUPPLIES/ *TORQUE

....

84K10153 (Mod-005) CNT#: NAS1-17403 DUN#: 041162330 CIC#: 1013309 National Aeronautics and Space Administration. Langley Research Center, Hampton, Va. Textron, Inc., Irvine, Calif.

UTTL: Flight crucial flight control systems state-of-technology survey UNCLASSIFIED JULY 25, 1983 / JUNE 30, 1985

TM: A/SPITZER, C. R. A/472

PI: B/REDIESS, H. REPORTS EXPECTED

MAJS: / *AUTOMATIC FLIGHT CONTROL/ *AVIONICS/ *FLIGHT CONTROL/ *SURVEYS/ *TECHNOLOGY ASSESSMENT

....

84A43401 ISSUE 21 PAGE 3104 CATEGORY 63 84/00/00 780 PAGES UNCLASSIFIED DOCUMENT

UTTL: Guidance and Control Conference, Seattle, WA, August 20-22, 1984, Technical Papers

SAP: Members, $55.; nonmembers, $70

CIO: UNITED STATES; Conference sponsored by the American Institute of Aeronautics and Astronautics. New York, American Institute of Aeronautics and Astronautics, 1984, 780 p. For individual items see A84-43402 to A84-43486.

MAJS: / *CONFERENCES/ *CONTROL THEORY/ *GUIDANCE (MOTION)

MINS: / AEROASSIST/ AIRCRAFT CONTROL/AUTOMATIC PILOTS/ COMMAND GUIDANCE/ COMPUTERIZED SIMULATION/ CONTROL SYSTEMS DESIGN/ FEEDBACK CONTROL/ FLIGHT CONTROL/ GLOBAL POSITIONING SYSTEM/ INERTIAL NAVIGATION/ OPTIMAL CONTROL/ OPTIMIZATION/ ORBITAL SERVICING/ POINTING CONTROL SYSTEMS/ PROPELLANT TANKS/ RADAR HOMING MISSILES/ SPACE NAVIGATION/ SPACECRAFT CONTROL/ STRAPDOWN INERTIAL GUIDANCE

ABA: O.C.

ABS: Among the guidance and control topics discussed are autonomous spacecraft navigation, aeroassisted orbital plane change, spacecraft applications of inertial energy storage wheels, miss distance dynamics in homing missiles, robust missile autopilot design, the Space Telescope Alternate Fine Guidance Sensor, instrument failure detection and isolation in a system with variable plant parameters, the control of forward swept wing configurations dominated by flight dynamic-aeroelastic interactions, Global Positioning System applications to geodesy, airborne gravity measurement with an astroinertial system, discrete optimal control solutions applicable to missile guidance, and maximum information guidance for homing missiles. Also considered are the analysis of a control concept for ejection seats, large flexible structure controllability improvements, multivari large aircraft, airborne wind shear detection, robust compensator synthesis by frequency-shaped estimation, digital flight mode control systems for high performance aircraft with flight propulsion control coupling, a model-following control system for helicopters, the maneuvering of distributed spacecraft, roll/yaw control of flexible

....

84A40143 ISSUE 19 PAGE 2816 CATEGORY 63 83/00/00 328 PAGES In RUSSIAN UNCLASSIFIED DOCUMENT

UTTL: Aircraft and spacecraft control — Russian book

AUTH: A/PETROV, B. N.

CIO: U.S.S.R.; Moscow, Izdatel'stvo Nauka (B. N. Petrov Izbrannye Trudy. Volume 2), 1983, 328 p. In Russian.

MAJS: / *AIRCRAFT CONTROL/ *CONTROL THEORY/ *FLIGHT CONTROL/ *OPTIMAL CONTROL/ * SPACECRAFT CONTROL

MINS: / AIRCRAFT INSTRUMENTS/ ATTITUDE CONTROL/ AUTOMATIC FLIGHT CONTROL/ FUEL CONTROL/ NAVIGATION INSTRUMENTS/ ONBOARD DATA PROCESSING/ REENTRY GUIDANCE / ROCKET ENGINE CONTROL/ SPACECRAFT INSTRUMENTS/ SYSTEMS ENGINEERING/TERMINAL GUIDANCE/ THRUST CONTROL/ VARIABLE GEOMETRY STRUCTURES

ABA: I.H.

ABS: The second edition of a collection of essays and articles on aircraft and spacecraft control by one of the founders of the Soviet space program is presented. Attention is given to general technical problems of aircraft control systems, including attitude control, control of spacecraft during reentry, and control of aircraft and spacecraft propulsion systems. Some technical issues in the design of automatic flight control systems, flight data management systems on board aircraft and spacecraft, and the application of data processing technology to radiosounding experiments in space are also briefly discussed.

....

84A29544 ISSUE 12 PAGE 1688 CATEGORY 8 RPT#: SAE PAPER 831486 83/00/00 5 PAGES UNCLASSIFIED DOCUMENT

UTTL: Future flight control capability development

AUTH: A/FLINN, E. H. PAA: A/(USAF, Wright-Patterson AFB, OH)

CIO: UNITED STATES; IN: Aerospace fluid power and control systems; Proceedings of the Aerospace Congress and Exposition, Long Beach, CA, October 3-6, 1983 (A84-29540 12-08). Warrendale, PA, Society of Automotive Engineers, Inc., 1983, p. 43-47.

MAJS: / *AIRBORNE/ SPACEBORNE COMPUTERS/ *AIRCRAFT CONTROL/ *ATTP,ATOC FLIGHT CONTROL/ *DIGITAL NAVIGATION/ *SYSTEMS INTEGRATION/ *TECHNOLOGICAL FORECASTING

MINS: /ALL-WEATHER AIR NAVIGATION/ ARCHITECTURE (COMPUTERS)/ BOMBER AIRCRAFT/ DATA MANAGEMENT/ FIGHTER AIRCRAFT/ NIGHT FLIGHTS (AIRCRAFT)/ ONBOARD DATA PROCESSING/ REAL TIME OPERATION

ABA: C.R.

ABS: A brief overview of emerging flight control technologies is presented which covers tactical flight management, advanced digital flight control, and integrated reference systems. The fighter-bomber pilot of the future, by using emerging developments in tactical flight management, will be able to operate at night in adverse weather conditions. He will fly and maneuver at low altitudes to achieve survivable penetration and threat avoidance. He will navigate precisely, arriving on time at very specific locations, and will be able to be redirected on a real-time basis to alternate targets of higher priority. In discussing advanced digital control, it is predicted that the impact of the explosion in digital computer development will be to allow the flight control system developer to design system architectures that will offer flexibility in meeting advanced tactical system objectives while providing improvements in system performance, reliability and maintainability.

....

84A29543 ISSUE 12 PAGE 1688 CATEGORY 8 RPT#: SAE PAPER 831485 83/00/00 14 PAGES UNCLASSIFIED DOCUMENT

UTTL: Flight control system development on the B-1 program

AUTH: A/KOZIOL, D. E.; B/BILLIPS, G. C.; C/PETERSEN, F. W. PAA: C/(Rockwell International Corp., El Segundo, CA)

CIO: UNITED STATES; IN: Aerospace fluid power and control systems; Proceedings of the Aerospace Congress and Exposition, Long Beach, CA, October 3-6, 1983 (A84-29540 12-08). Warrendale, PA, Society of Automotive Engineers, Inc., 1983, p. 29-42.

MAJS: / *AIRCRAFT CONTROL/ *B-1 AIRCRAFT/ *FAIL-SAFE SYSTEMS/ *FLIGHT CONTROL/ *FLY BY WIRE CONTROL/ *RELIABILITY ENGINEERING

MINS: / ACTUATORS/ AUTOMATIC FLIGHT CONTROL/ EVOLUTION (DEVELOPMENT)/ FLIGHT SIMULATION/ FLIGHT TESTS/ GROUND TESTS/ MANUAL CONTROL/ TERRAIN FOLLOWING AIRCRAFT

ABA: Author

ABS: The B-1 is a long-range strategic bomber designed to perform safely in a hostile environment with a high probability of mission success. The flight control system achieves these objectives with redundant hybrid combinations of fly-by-wire and conventional design techniques. The primary mode of control in each axis is fail-operational, fail-safe, fly-by-wire with simultaneously operating mechanical control. The flight control system is described, and selected flight and ground test experiences and resultant development activity are discussed. Developments include reduction of force fight in surfaces with multiple actuators, reduction of horizontal stabilizer control hysteresis, elimination of pitch control/structural mode coupling, reduction in lower rudder load oscillations, increase in the operational reliability of the flap/slat system, elimination of the susceptibility of the augmentation system to electrical power transients, and other items.

....

84A26701 ISSUE 11 PAGE 1504 CATEGORY 6 83/00/00 746 PAGES UNCLASSIFIED DOCUMENT

UTTL: Digital Avionics Systems Conference, 5th, Seattle, WA, October 31-November 3, 1983, Proceedings

SAP: Members, $28.; nonmembers, $56

CIO: UNITED STATES; Conference sponsored by the Institute of Electrical and Electronics Engineers and American Institute of Aeronautics and Astronautics. New York, Institute of Electrical and Electronics Engineers, 1983, 746 p.

MAJS: / *AIRBORNE/ SPACEBORNE COMPUTERS/ *AVIONICS/ *CONFERENCES/ *DIGITAL SYSTEMS

MINS: /AIRCRAFT CONTROL/ AUTOMATIC FLIGHT CONTROL/COMMERCIAL AIRCRAFT/ COMPUTER PROGRAMS/ DIGITAL NAVIGATION/ HIGH LEVEL LANGUAGES/ IN-FLIGHT MONITORING/ ONBOARD DATA PROCESSING/ PRODUCT DEVELOPMENT/ ROTORCRAFT AIRCRAFT/ SYSTEMS INTEGRATION/ SYSTEMS SIMULATION/ TECHNOLOGICAL FORECASTING/ V/STOL AIRCRAFT/ VHSIC (CIRCUITS)

ABA: G.R.

ABS: The subjects discussed are related to fault tolerant avionics, avionics support systems, advanced technology for digital systems, management techniques for software development and maintenance, system simulation for effectiveness evaluation, flight experience with digital flight control systems, advanced avionics systems, avionics for V/STOL and rotorcraft, and commercial aircraft systems. Aspects of operational aircraft digital avionics are considered along with VHSIC applications and technology, integrated CNI on-board terminals, integrated map techniques, on-board monitoring and support, sensor and signal processing, new concepts regarding digital flight control systems, data bus techniques and applications, avionics flight software, general aviation avionics, integrated systems, an integrated crew station, and on-board ATC systems. Attention is given to the digital avionics revolution, achievements and challenges with respect to digital avionics standards, digital avionics design decisions involving new commercial transport aircraft, and the digital aircraft from a pilot's perspective. For individual items see A84-26702 to A84-26806

....

84A16526 ISSUE 5 PAGE 535 CATEGORY 1 83/00/00 1565 PAGES UNCLASSIFIED DOCUMENT

UTTL: NAECON 1983; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 17-19, 1983. Volumes 1 & 2

SAP: Price of two volumes, $53.50

CIO: UNITED STATES; Conference sponsored by the Institute of Electrical and Electronics Engineers, Itek Corp., Computer Sciences Corp., et al. New York, Institute of Electrical and Electronics Engineers, 1983, vol. 1, 748 p.; vol. 2, 817 p.

MAJS: / *AEROSPACE SYSTEMS/ *AVIONICS/ *CONFERENCES/ *SPACECRAFT ELECTRONIC EQUIPMENT

MINS: / AIRBORNE/SPACEBORNE COMPUTERS/ AUTOMATIC FLIGHT CONTROL/ DATA SYSTEMS/DIGITAL NAVIGATION/ ELECTRIC POWER SUPPLIES/ ELECTROMAGNETIC COMPATIBILITY / FIRE CONTROL/ KALMAN FILTERS/ MAN MACHINE SYSTEMS/ RADAR TRACKING/ ROBOTICS/ SIGNAL PROCESSING

ABA: B.J.

ABS: Topics discussed include the all electric aircraft; aerospace power systems development; electromagnetic compatibility; robotics; CAD/CAM; air data systems; navigation systems; controls and displays; Kalman

filtering and signal processing applications; flat panel display technology; airborne image processing and targeting application; airborne automatic target recognition/acquisition; pointing, tracking, and stabilization; airborne radar and fire control technology; airborne computers and multiplex; advanced avionics systems; and digital systems. Consideration is also given to maintenance trainers, visual and electrooptical sensor simulation; software management and engineering techniques; human/machine system analysis; workload assessment; environmental interactions; physiological/medical interfaces; AFTI/F-16 flight development summary; integrated control; flying qualities; and flight management. For individual items see A84-16527 to A84-16696.

....

84A11999 ISSUE 2 PAGE 213 CATEGORY 63 CNT#: STU-82-3430 83/09/00 16 PAGES UNCLASSIFIED DOCUMENT

UTTL: Theory and applications of adaptive control - A survey

AUTH: A/ASTROM, K. J. PAA: A/(Lund Institute of Technology, Lund, Sweden)

CIO: SWEDEN; Automatica (ISSN 0005-1098), vol. 19, Sept. 1983, p. 471-486. Sponsorship: Styrelsen for Teknisk Utveckling.

MAJS: / *ADAPTIVE CONTROL/ *CONTROL THEORY/ *FEEDBACK CONTROL/ *STOCHASTIC PROCESSES / *TECHNOLOGY ASSESSMENT/ *TECHNOLOGY UTILIZATION

MINS: / AUTOMATIC PILOTS/ BIBLIOGRAPHIES/ CONVERGENCE/ FEASIBILITY ANALYSIS/ PARAMETERIZATION/ REGULATORS/ SYSTEMS STABILITY/ TUNING

ABA: Author

ABS: Progress in theory and applications of adaptive control is reviewed. Different approaches are discussed with particular emphasis on model reference adaptive systems and self-tuning regulators. Techniques for analyzing adaptive systems are discussed. This includes stability and convergence analysis. It is shown that adaptive control laws can also be obtained from stochastic control theory. Issues of importance for applications are covered. This includes parameterization, tuning, and tracking, as well as different ways of using adaptive control. An overview of applications is given. This includes feasibility studies as well as products based on adaptive techniques.

....

84A11175 ISSUE 1 PAGE 13 CATEGORY 8 82/00/00 12 PAGES UNCLASSIFIED DOCUMENT

UTTL: Integrated airframe/propulsion controls technology

AUTH: A/GUPTA, N. K.; B/TRAVASSOS, R. H. PAA: B/(Integrated Systems, Inc., Palo Alto, CA)

CIO: UNITED STATES; In: NAECON 1982; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 18-20, 1982. Volume 2. (A83-11083 01-01) New York, Institute of Electrical and Electronics Engineers, Inc., 1982, p. 780-791.

MINS: / AIRBORNE/SPACEBORNE COMPUTERS/ AIRCRAFT DESIGN/ ARCHITECTURE (COMPUTERS) / CONTROL THEORY/ FAULT TOLERANCE/ MULTIPROCESSING (COMPUTERS)/ PARALLEL PROCESSING (COMPUTERS)

ABA: C.D.

ABS: Integrated aircraft control technologies and issues are examined and potential approaches to integrated airframe/propulsion control development are reviewed. Classical control architecture and the manner in which it meets aircraft control requirements are shown. Aircraft control requirements and emerging technologies which will help meet future mission requirements are discussed. Advanced multivariable control methods such as hierarchical control and frequency-shaping methods which are useful for integrated control computations are described. Integrated control system architectures are addressed, including the Multivariable Control Processor, the Redundant Common Bus Processor, and the Centralized Processor Redundant Actuator/Sensor System.

....

86A15396 ISSUE 4 PAGE 522 CATEGORY 74 RPT#: SPIE-512 85/00/00 152 PAGES UNCLASSIFIED DOCUMENT

UTTL: Fiber optic communication technology; Proceedings of the Meeting, San Diego, CA, August 23, 24, 1984

AUTH: A/KLEEKAMP, C. W. PAA: A/(Mitre Corp., Bedford, MA) PAT: A/ED.

SAP: Members, $33.; nonmembers, $43

CIO: UNITED STATES; Meeting sponsored by SPIE - The International Society for Optical Engineering. Belingham, WA, SPIE - The International Society for Optical Engineering (SPIE Proceedings. Volume 512), 1985, 152 p. For individual items see A86-15397 to A86-15399.

MAJS: / *CONFERENCES/ *FIBER OPTICS/ *OPTICAL COMMUNICATION/ *TECHNOLOGY ASSESSMENT

MINS: / ATTENUATION CO-EFFICIENTS/ DATA PROCESSING/ DATA TRANSMISSION/ DEMULTIPLEXING/ ELECTRO-OPTICS/ FREQUENCY RESPONSE/ LASER APPLICATIONS/ LOCAL AREA NETWORKS/ LONG WAVE RADIATION/ METAL HALIDES/ METAL OXIDES/MULTIPLEXING/ SHORT WAVE RADIO TRANSMISSION/ SIGNAL DISTORTION/ SOLID STATE LASERS/ TECHNOLOGY ASSESSMENT/ WAVELENGTH DIVISION MULTIPLEXING

ABA: G.R.

ABS: Fiber optic components are considered, taking into account a review of ~~developments related to~~ optical fibers, a review of fiber optic cable technology, aspects of fiber system testing, fiber optic splices, a critical review of fiber optic connectors, and fiber optic communication technology branching devices. Developments concerning fiber optic systems are also discussed, giving attention to optoelectronic issues in fiber optic communications, digital fiber optic systems, wideband analog fiber optic systems, fiber optic local area networks, and wavelength division multiplexing.

....

85A10576 ISSUE 1 PAGE 30 CATEGORY 35 83/00/00 279 PAGES UNCLASSIFIED DOCUMENT

UTTL: Advanced infrared sensor technology; Proceedings of the Meeting, Geneva, Switzerland, April 18, 19, 1983

AUTH: A/BESSON, J.

PAA: A/(Societe Anonyme de Telecommunications, Paris, France)

PAT: A/ED.

SAP: Members, $36.; nonmembers, $42

CIO: UNITED STATES; Meeting sponsored by SPIE - The International Society for Optical Engineering, Association Nationale de la Recherche Technique, Associazione Elettrotecnica ed Elettronica Italiana, et al. Bellingham, WA, SPIE - The International Society for Optical Engineering (SPIE Proceedings. Volume 395), 1983, 279 p. For individual items see A85-10577 to A85-10597.

MAJS: / *CONFERENCES/ *INFRARED DETECTORS/ *INFRARED IMAGERY/ *REMOTE SENSORS

MINS: /AVALANCHE DIODES/ CHARGE COUPLED DEVICES/ FIBER OPTICS/ FOCAL PLANE DEVICES/ IMAGE RESOLUTION/ INFRARED ASTRONOMY SATELLITE/ INFRARED TELESCOPES/ INTEGRATED CIRCUITS/ LINEAR ARRAYS/ OPTICAL COMMUNICATION/ PHOTODIODES/ SCHOTTKY DIODES/ SPACEBORNE ASTRONOMY/ TECHNOLOGY UTILIZATION

ABA: G.R.

ABS: Detectors for optical communication are discussed, taking into account receivers for longer wavelength optical communication systems, photodetectors for long wavelength optical fiber communication systems, Ge and InGaAs avalanche photodiodes for long wavelength optical communication use, a Cd Hg Te (1.3 micron - 1.55 micron) avalanche photodiode, qualification test results of pigtailed P(pi)IN APD's, high frequency wavelength modulation spectroscopy with diode lasers for optical memory applications, and a comparison of infrared sensor technologies for telecommunications and thermal imaging systems. Aspects related to focal plane array technology are also explored, giving attention to HgCdTe infrared focal plane arrays for imaging spectrometer applications, a meander channel CCD infrared imager with a platinum silicide Schottky barrier, In Sb infrared rays with S-CCD readout, and the impact of focal plane technologies on IR system design. Topics related to

spaceborne and astronomical sensors and the application of infrared sensors in civilian areas are also considered.

....

84X74058# CATEGORY 74 RPT#: AD-B079356L AD-E500610 IDA-D-33-PT-2 IDA/HQ-83-28103-PT-2 CNT#: MDA903-79-C-0018 83/08/00 270 PAGES UNCLASSIFIED DOCUMENT US GOV AGENCIES

UTTL: Fiber optics technology working group report (IDA/OSD R&M (Institute for Defense Analyses/Office of the Secretary of Defense Reliability and Maintainability) study), part 2

TLSP: Final Report, Jul. 1982 - Aug. 1983

AUTH: A/GLISTA, A. S., JR.; B/KATZ, R. S.

CORP: Institute for Defense Analyses, Alexandria, Va.

CSS: (Science and Technology Div.)

CIO: UNITED STATES

MAJS: / *FIBER OPTICS/ *MAINTAINABILITY/ *MILITARY TECHNOLOGY/ *OPTICAL COMMUNICATION/ *RELIABILITY/ *TECHNOLOGY ASSESSMENT

MINS: /DETECTION/ LIFE CYCLE COSTS/ LIGHT TRANSMISSION/ LOGIC CIRCUITS/ LOGISTICS/ OPTICAL EQUIPMENT/ PEACETIME/ SECURITY/ TECHNOLOGY UTILIZATION/ WEAPON SYSTEMS

....

84X73435# CATEGORY 74 RPT#: AD-B077848L RADC-TR-83-73 CNT#: F19628-82-C-0001 AF PROJ. 4519 83/06/00 80 PAGES UNCLASSIFIED DOCUMENT US GOV AGENCIES

UTTL: Multipurpose fiber optic transceiver (MFOX) program TLSP: Final Technical Report

AUTH: A/KLEEKAMP, C. W.

CORP: Mitre Corp., Bedford, Mass.

CIO: UNITED STATES; Griffiss AFB, N.Y. RADC

MAJS: / *COMMAND AND CONTROL/ *FIBER OPTICS/ *MISSILE CONTROL/ *OPTICAL COMMUNICATION/ *TRANSMITTER RECEIVERS/ *USER REQUIREMENTS

MINS: / AVALANCHE DIODES/ DIGITAL COMMAND SYSTEMS/ DIODES/ LIGHT EMITTING DIODES / MISSILE SYSTEMS/ MODEMS/ OPTIMIZATION/ P-I- JUNCTIONS/ RETROFITTING/ TARGET ACQUISITION

....

84K11473 (Sup-010) CNT#: NAG3-571 DUN#: 071124788

CIC#: 1029370 505-40-5B 505-62-01 National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio. A/OAST John Carroll Univ., Cleveland, Ohio.

UTTL: Digital optical sensors using wavelength division multiplexing and interferometer techniques UNCLASSIFIED OCTOBER 1, 1984 / FEBRUARY 14, 1988

TM: A/BAUMBICK, R. J. A/2034

PI: B/FRITSCH, K. REPORTS EXPECTED

MAJS: / *COMBUSTION CONTROL/ *OPTICAL MEASURING INSTRUMENTS/ *PROPULSION/ *PROPULSION SYSTEM PERFORMANCE/ *PROPULSIVE EFFICIENCY

....

84A26450 ISSUE 11 PAGE 1536 CATEGORY 32 82/00/00 5 PAGES UNCLASSIFIED DOCUMENT

UTTL: High speed fiber optic data bus for local data communications

AUTH: A/PORTER, D. R.; B/COUCH, P. R.; C/SCHELIN, J. W.

PAA: C/(ITT, ITT Electro-Optical Products Div., Roanoke, VA)

CIO: UNITED STATES; IN: Globecom '82 - Global Telecommunications Conference, Miami, FL, November 29-December 2, 1982, Conference Record. Volume 3 (A84-26401 11-32). New York, Institute of Electrical and Electronics Engineers, 1982, p. 956-960.

MAJS: /CHANNELS (DATA TRANSMISSION)/ *FIBER OPTICS/ *NEEDS (DATA SYSTEM)/ *OPTICAL COMMUNICATION/ *TIME DIVISION MULTIPLEXING

MINS: / DATA BASE MANAGEMENT SYSTEMS/ ERROR ANALYSIS/ NASA PROGRAMS/ OPTICAL COUPLING

ABA: Author

ABS: Over the past decade the volume of data compiled in industrial, military, and scientific data bases has increased to enormous proportions. This increase has lead to the development of ne techniques for economically transporting information locally at high data rates. Leading among these techniques is the serial asynchronous multiterminal time division multiplexed data bus. This paper describes a 100 Mb/s fiber optic data bus system for connecting 16 terminals separated by up to 2 km. The system was developed as part of a NASA Data Base Management System for archiving and retrieving of satellite data.

....

82N76663# CATEGORY 32 RPT#: PB81-860710 81/02/00 223 PAGES UNCLASSIFIED DOCUMENT

UTTL: Infrared communications. Citations from the Information Services for the physics and engineering communities data base

TLSP: Progress Report, Jan. 1975 - Jan. 1981

CORP: National Technical Information Service, Springfield, Va. AVAIL.NTIS

SAP: HC $30.00/MF $30.00

CIO: UNITED STATES

MAJS: / *BIBLIOGRAPHIES/ *INFRARED SPECTRA/ *OPTICAL COMMUNICATION

MINS: / ATMOSPHERIC TEMPERATURE/ HUMIDITY/ RECEIVERS/ REMOTE CONTROL/ TRANSMITTERS

....

82N12314# ISSUE 3 PAGE 329 CATEGORY 32 RPT#: AD-A105118 HDL-TR-1940 81/07/00 29 PAGES UNCLASSIFIED DOCUMENT

UTTL: An advanced 500-MHZ-bandwidth fiber-optic signal link for EMP and general laboratory applications TLSP: Technical Report, Sep. 1978 - Nov. 1979

AUTH: A/BLACKBURN, J. C.

CORP: Harry Diamond Labs., Adelphi, Md. AVAIL.NTIS

SAP: HC A03/MF A01

CIO: UNITED STATES; Sponsored in part by Defense Nuclear Agency

MAJS: / *BROADBAND AMPLIFIERS/ *ELECTROMAGNETIC PULSES/ *FIBER OPTICS/ *OPTICAL COMMUNICATION/ *OPTICAL WAVEGUIDES

MINS: / CALIBRATING/ NUMERICAL CONTROL/ RECEIVERS/ REMOTE CONTROL/ TRANSMITTERS

ABA: Author (GRA)

ABS: Means have been found to control modal noise in a fiber-optic system using single-mode lasers. Laser coherence

is reduced by dithering, and careful attention is given to fiber connections. These techniques, in combination with miniaturization, have produced a compact wideband analog fiber-optic link that is well suited to signal transmission where dielectric transmission is dictated by electrical noise, need for complete isolation, TEMPEST considerations, or a requirement for wide bandwidth. The optical transmitter has a volume of 550 cc, contains an optically remote-controlled 0- to 45-dB input attenuator and calibrator, and will operate for 2 hr on its internal batteries. Maximum input sensitivity is a few millivolts into 50 ohms, system risetime in 0.8 ns, and dynamic range is greater than 30 dB. Transmission distances up to kilometers are possible, although fiber dispersion will reduce bandwidth at long distances.

....

82A28585 ISSUE 13 PAGE 2082 CATEGORY 37 81/00/00 38 PAGES UNCLASSIFIED DOCUMENT COPYRIGHT

UTTL: Laboratory testing of rubber-to-metal bonds

AUTH: A/CUTTS, E.

PAA: A/(Malaysian Rubber Producers' Research Association, Brickendonbury, Herts., England)

CIO: UNITED KINGDOM

In: Developments in adhesives - 2. (A82-28576 13-39) London, Applied Science Publishers, 1981, p. 367-404.

MAJS: / *ADHESION TESTS/ *FAILURE ANALYSIS/ *METAL BONDING/ *RESIN BONDING/ *RUBBER

MINS: / ADHESIVE BONDING/ AEROSPACE ENGINEERING/ ELECTRON MICROSCOPY/ PEELING/ QUALITY CONTROL/ TENSILE STRENGTH

ABA: G.R.

ABS: Components using rubber-to-metal bonds are widely used in engineering, where the metal can serve two functions, providing a means of attachment or a means of modifying the properties of the component. Such components are used as bearings for the booster rocket motors of the Space Shuttle. The laboratory testing of strong engineering rubber-to-metal bonds are discussed, taking into account the ASTM D429 methods A-C, which are widely used in industry for development and quality control. The classification of bond failure types is considered, and attention is given to the direct tension test, the peel test, and the cone test. The factors influencing bond strength are investigated, taking into account the effect of the metal, the effect of the bonding system, the effect of the rubber compound, and the effect of the moulding conditions on bond strength.

....

No: A4 **Title:** No Hardwire to Vehicle; Minimal Launch Control Interface; No Ground Power

Operations Requirement:

Minimize hardwire connections to vehicle to simplify vehicle erection and pad connection sequence. Also, drastically reduce quantity of control and data functions from LCC to pad. Eliminate requirement for ground power.

Rationale:

All systems must be dramatically reduced or simplified to achieve required cost reduction. O&M of vehicle hard connects is costly and labor intensive.

Sample Concept:

Vehicle electrical power is self-contained via high density power cells. Essential ground control functions are relayed to the vehicle via RF, infrared, or equivalent non-hard-connect and related GSE to vehicle. Vehicle connects limited to propellants, holddown mechanism, and electrical ground.

Technology Requirement:

Remote RF and infrared control techniques are in existence. No technology breakthrough required except development of high-density energy cells (see E).

Technology References:

NASA/RECON: 86A15396, 85A10576, 84X74058, 84X73435, 84K11473
84A26450, 82N76663, 82N12314, 82A28585

See also E.

No.: A5 **Title:** Software Commonality

Operational Requirement:

The vehicle should utilize the same software for ground operations test and integration as for flight.

Rationale:

Current STS ground operations is accomplished with several different programs depending on the stage of testing. This results in many hours of wasted time in reloading the main computer memory. For example the final prelaunch load requires 14 clock-hours to accomplish.

Sample Concept:

The Avionics should be designed as a distributed system with one or more high speed buses providing communications between subsystems as required.

Each subsystem should have the capability of autonomous ground operations by commanding the system into standalone mode. In this mode all required external stimuli would be simulated by the subsystem in sufficient manner to verify it's proper operation. This would allow each subsystem to be tested independently of the operational state of the other systems. When all ground testing and vehicle integration is complete each subsystem would be commanded to the flight mode without additional computer reloading.

Technology Requirement:

Distributed architecture.

Technology References:

IUS software.

No.: E **Title:** Eliminate Requirement for Ground Power

Operational Requirement:

Ideal Innovation: Vehicle systems that operate without requirement for ground power connection at any time during checkout or launch operations. This directly implies an onboard power source capable of providing sufficient power for ground O&M, T&C/O, and launch operations without connection to facilities or GSE.

Further, provide a low maintenance state-of-the-art energy storage source. If energy source requires LOX, it should use propellant-grade O_2.

Rationale:

Vehicle "Power-Up" is one continually repetitive "BIG DEAL". Each power-up at the OPF, VAB, or Pad requires a "daisy chain" of scheduling, extensive command, control, and communication between the orbiter location and LCC, and dozens of people manning consoles and computers. The requirement for ground power also requires complex GSE, sensitive umbilical connections and, usually, towers with swingarms. These all require extensive checkout time and personnel (engineers, technicians, mechanics, inspectors, and clerks) to support.

It is very highly desirable for individual vehicle sysytems to have local, autonomous test and C/O capability independent of vehicle master power status. Ideally, vehicle power would always be available and each system could use, or be isolated from, power at local discretion.

Requirement for special high-grade O_2 for fuel cells creates additional logistics, GSE, personnel, and timeline needs creating an "invisible tentpole" far in excess of the 5-to-1 commodity price differential for the modest 2443 lb. orbiter system capacity.

Sample Concept:

High density energy storage systems, such as regenerative fuel cells or sodium/sulphur batteries to provide adequate on-board power for ground O&M, T&C/O. Fuel cells should be capable of using propellant-grade O_2. Circa May 1988 fuel cell grade O_2 cost 4.8 times more than propellant grade ($264/ton vs. $55/ton).

Technology Requirement:

Admittedly, a "gee-whiz" power system (not yet available) is a great need. Accelerated development of energy storage systems is needed with emphasis on fuel cells and consideration/development of sodium/sulphur batteries. This criterion, with 59 tech references, is no doubt one of the most severe.

Technology References:

NASA/RECON (abstacts attached):
87X70518, 87N22801, 87N19811, 87N19809, 87N17397, 87N16453, 87N14860, 87N12998, 87A33793, 87A33790, 87A33787, 87A33778, 87A15901, 87A14170, 86X73564, 86X73563, 86X72121, 86X71138, 86X70734, 86N28331, 86N28329, 86N27586, 86N23047, 86N17886, 86N16734, 86N16495, 86N14764, 86C12215, 86B10483, 86B10277, 86A37201, 86A36369, 86A24845, 85X76813, 85X72247, 85N71096, 85N33588, 85N31372, 85N16292, 85N13880, 85N13850, 85A45422, 85A33144, 85A26700, 85A26501, 85A12599, 84X75772, 84N31535, 84N12246, 84N10493, 84A30956, 84A30107, 84A30103, 83N14683, 81N22305, 81K10462, 80A20128, 75N24837

DIALOG (abstract attached): 1384056

PAGE 114 INTENTIONALLY BLANK

87X70518

AGENCIES UTTL: Lithium aqueous battery for aircraft propulsion

TLSP: Interim Report, Sep. 1983 - Feb. 1985

AUTH: A/EVERETT, H.; B/RONDINI, R.; C/GORDON, A.; D/RALKAR, R.

CORP: Gould, Inc., Cleveland, Ohio. CSS: (Ocean Systems Div.) MFC: 00

CIO: UNITED STATES

MAJS: / *ELECTRIC BATTERIES/ *ELECTRIC PROPULSION/ *ELECTROLYTIC CELLS/ *FUEL CELLS / *LITHIUM SULFUR BATTERIES

MINS: / AIRCRAFT ENGINES/ CELL ANODES/ CELL CATHODES/ ELECTROCATALYSIS/ ELECTROCHEMISTRY/ HYDROGEN PEROXIDE

....

87N22801# ISSUE 16 PAGE 2140 CATEGORY 20 RPT#: AD-A178869 AFIT/GSO/ENP/86D-1 86/11/00 71 PAGES UNCLASSIFIED DOCUMENT

UTTL: Investigation of rocket powered, open cycle, magnetohydrodynamic generators for high, pulsed power needs in space.

TLSP: M.S. Thesis

AUTH: A/POWER, JOHN W.

CORP: Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.

CSS: (School of Engineering.)

SAP: Avail: NTIS HC A04/MF A01

CIO: UNITED STATES

AJS: / *ELECTRICAL RESISTIVITY/ *MAGNETOHYDRODYNAMIC GENERATORS/ *NUCLEAR POWER PLANTS/ *PULSES/ *SPACECRAFT POWER SUPPLIES/ *THRUST

MINS: / DEFLECTORS/ ROCKET ENGINES/ ROCKET EXHAUST/ SOLAR CELLS/ SOLENOIDS/ SPACE SHUTTLES/ SUPERCONDUCTORS

ABA: GRA

ABS: This investigation examined the possibility of using a rocket powered magnetohydrodynamic generator for pulse power in space of 300 megawatts (MW). The result is a preliminary design of an MHD generator using an open cycle disk channel and a single superconductng solenoid coil. The disk channel acts as a thrust deflector, and internal vanes counteract induced vorticity. The use of a solid fuel wafer grain design rocket motor is proposed for increased electrical conductivity and pulse operation of the generator. Using conservative parameters, a generator design capable of being carried on one or two space shuttle launches is developed with estimated mass of 24,450kg and estimated power output of 1346MW. The nominal operation time before refurbishment i 115 seconds; the restriction operation time is deterioration of the channel throat. This design exceeds present nuclear and solar cell power systems in power output per unit mass.

....

87N19811# ISSUE 12 PAGE 1649 CATEGORY 44 RPT#: DE87-001474 CONF-860810-39 CNT#: W-31-109-ENG-38 86/00/00 15 PAGES UNCLASSIFIED DOCUMENT

UTTL: Monolithic fuel cells

AUTH: A/FEE, D. C.; B/BLACKBURN, P. E.; C/BUSCH, D. E.; D/CLAAR, T. D.; E/DEES, D. W.; F/DUSEK, J.; G/EASLER, T. E.; H/ELLINGSON, W. A.; I/FLANDERMEYER, B. K.; J/FOUSEK, R. J.

CORP: Argonne National Lab., Ill.

SAP: Avail: NTIS HC A02/MF A01

CIO: UNITED STATES; Presented at the Intersociety Energy Conversion Engineering Conference, San Diego, Calif., 25 Aug. 1986

MAJS: /*DESIGN ANALYSIS/ *FABRICATION/ *FUEL CELLS/ *REGENERATION (ENGINEERING)

MINS: /CERAMICS/ CURRENT DENSITY/ HONEYCOMB STRUCTURES

ABA: DOE

ABS: The monolithic design employs the same thin ceramic components used in other oxide fuel cells in a strong, lightweight honeycomb structure of small cells, and thus can achieve very high power per unit mass or volume. The light weight and low volume, as well as the efficiency and reliability of electrical systems, are advantageous in space systems. Considerable progress has been made in developing monolithic fuel cells. Cells of the monolithic design have been fabricated and operated. High current densities have been achieved. Arrays of the monolithic design having prototypical dimensions have been fabricated and operated.

....

87N19809# ISSUE 12 PAGE 1648 CATEGORY 44 RPT#: DE86-006619 &DOE/METC-86-0241 5/00/00 61 PAGES UNCLASSIFIED DOCUMENT

UTTL: Fuel cells TLSP: Technology Status Report

CORP: Morgantown Technology Center, W. Va.

SAP: Avail: NTIS HC A04/MF A01

CIO: UNITED STATES

MAJS: /*CONTRACTORS/ *FUEL CELLS/ *GOVERNMENT/INDUSTRY RELATIONS/ *RESEARCH MANAGEMENT/ *TECHNOLOGY ASSESSMENT

MINS: /ANODES/ CATHODES/ EFFICIENCY/ ELECTROCATALYSTS/ FABRICATION/ MANUFACTURING/ NATURAL GAS/ SENSITIVITY/ SOLID ELECTROLYTES

ABA: DOE

ABS: The status of the US Department of Energy's Fuel Cells Program at the end of FY 85 is described. The report consists of: (1) an overview of the Fuel Cells Program including a brief discussion of how fuel cells work; (2) a synopsis of the Phosphoric Acid Fuel Cell (PAFC), Molten Carbonate Fuel Cell (MCFC), and Solid Oxide Fuel Cell (SOFC) Programs and their 1985 projects; (3) a discussion of the Fuel Cells Advanced Research and Technology Development (AR and TD) Program and projects; and (4) a summary of the Fuel Cells Systems and Applications Program. A common direction of fuel cell development has been to combine individual cells into groups called stacks or modules in order to increase power output. In 1985, the scale-up of PAFC stacks to the 40-kW level continued, and a project involving the manufacturing of 46 power plants was completed. SOFC scale-up proceeded to the 24-cell submodule stage. An MCFC 1-ft stack demonstrated effective management of electrolyte, control of end-cell shorting, and resistance of separator plates to corrosion during 4000 hours of operation. AR and TD provided information on reaction mechanisms and materials for MCFC's, SOFC's, and PAFC's.

....

87N17397*# ISSUE 9 PAGE 1238 CATEGORY 44 RPT#: NASA-CR-180127 JPL-PUB-86-14 NAS 1.26:180127 CNT#: NAS7-918 86/7/15 99 PAGES UNCLASSIFIED DOCUMENT

UTTL: The NASA Aerospace Battery Safety Handbook

AUTH: A/HALPERT, GERALD B/ SUBBARAO, SURAMPUDI; C/ROWLETTE, JOHN J.

CORP: Jet Propulsion Lab., California Inst. of Tech., Pasadena.

SAP: Avail: NTIS HC A05/MF A01

CIO: UNITED STATES

MAJS: /*AEROSPACE ENVIRONMENTS/ *ELECTROCHEMICAL CELLS/ *ENERGY STORAGE/ *FUEL CELLS/ *SAFETY MANAGEMENT/ *SPACE SHUTTLES/

*STORAGE BATTERIES

MINS: /ANODES/ HAZARDS/ LITHIUM/ SPACECRAFT POWER SUPPLIES/ SPACECRAFT PROPULSION/ ZINC

ABA: Author

ABS: This handbook has been written for the purpose of acquainting those involved with batteries with the information necessary for the safe handling, storage, and disposal of these energy storage devices. Included in the document is a discussion of the cell and battery design considerations and the ole of the components within a cell. The cell and battery hazards are related to user and/or manufacturer-induced causes. The Johnson Space Center (JS) Payload Safety Guidelines for battery use in Shuttle applications are also provided. The electrochemical systems are divided into zinc anode and lithium anode primaries, secondary cells, and fuel cells. Each system is briefly described, typical applications are given, advantages and disadvantages are tabulated, and most importantly, safety hazards associated with its use are given.

....

87N16453# ISSUE 8 PAGE 1075 CATEGORY 44 RPT#: DE86-014953 8DOE/CE-0121/1 6/01/00 45 PAGES UNCLASSIFIED DOCUMENT

UTTL: Electrochemical energy storage program TLSP: Annual Progress Report, 1 Oct. 1984 - 30 Sept. 1985

CORP: Department of Energy, Washington, D. C. CSS: (Office of Energy Storage and Distribution.)

SAP: Avail: NTIS HC A03/MF A01

CIO: UNITED STATES

MAJS: /*ELECTRIC BATTERIES/ *ELECTRIC ENERGY STORAGE/ *ELECTROCHEMICAL CELLS/ *FUEL CELLS

MINS: /ELECTROCATALYSIS/ ELECTROLYTES/ LITHIUM SULFUR BATTERIES/ METAL AIR BATTERIES/ NICKEL HYDROGEN BATTERIES/ SODIUM SULFUR BATTERIES

ABA: DOE

ABS: Research on the following topics is summarized: metal/air batteries, ambient temperature lithium batteries, sodium/sulfur batteries, lithium/iron sulfide batteries, fuel cells, hydrogen/nickel oxide batteries, flow batteries.

....

87N14860# ISSUE 6 PAGE 805 CATEGORY 54 RPT#: ETN-87-98860 86/00/00 23 pages in German UNCLASSIFIED DOCUMENT DCAF E002631

UTTL: Life support and energy supply systems for manned European return spacecraft (technological requirements)

AUTH: A/REICHERT, R.

CORP: Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).

SAP: Avail: NTIS HC A02/MF A01

CIO: GERMANY,FEDERAL REPUBLIC OF; Presented at ILA 86 Symposium, Hanover, West Germany, 6 Jun. 1986; sponsored by Hermann-Oberth-Gesellschaft e.V.

MAJS: /*EUROPEAN SPACE PROGRAMS/ *LIFE SUPPORT SYSTEMS/ *MANNED SPACECRAFT/ *RETURN TO EARTH SPACE FLIGHT/

*SPACECRAFT POWER SUPPLIES

MINS: /FUEL CELLS/ MISSION PLANNING/ SYSTEMS ENGINEERING/ TECHNOLOGY ASSESSMENT

ABA: ESA

ABS: The requirements and technological preparations of the life support and energy supply subsystems for European manned missions are reviewed. Concerning life support systems, mission requirements, specifications, system components, requirements for extravehicular activities, and ESA technology programs are presented. In the field of energy supply (fuel cells), mission requirements, fuel cells and systems components, and ESA technological preparations are outlined.

....

87N12998# ISSUE 4 PAGE 513 CATEGORY 44 RPT#: DE86-011070 CONF-860810-9 CNT#: E-AC05-84OR-21400 86/00/00 5 PAGES UNCLASSIFIED DOCUMENT

UTTL: Development of regenerable energy storage for space multimegawatt applications

AUTH: A/OLSZEWSKI, M.

CORP: Oak Ridge National Lab., Tenn.

SAP: Avail: NTIS HC A02/MF A01

CIO: UNITED STATES; Presented at the Intersociety Energy Conversion Engineering Conference, San Diego, Calif., 25 Aug., 1986

MAJS: /*ELECTRIC BATTERIES/ *ENERGY STORAGE/ *FUEL CELLS/ *SPACE WEAPONS/ * SPACECRAFT POWER SUPPLIES

MINS: /FEASIBILITY ANALYSIS/ TECHNOLOGY UTILIZATION/ WEAPON SYSTEMS

ABA: DOE

ABS: A program has recently been initiated as a part of the national Strategic Defense Initiative (SDI) to develop energy storage technology for space power applications. This program is jointly conducted by the Department of Energy and the Department of Defense. It is focused on the development of advanced technologies in regenerable energy storage that will be required for generation of multimegawatt levels of sprint power for SDI space missions. Energy storage technology considered in the program relate to devices that have a high specific capacity for energy storage, which can provide high levels of electric power on demand, and which may be recharged with electric power. The devices of principal interest are electrochemical batteries, chemical fuel cells, and electromechanical flywheels (the latter includes the motors and generators used to provide the electrical to mechanical coupling). The intent of the program is to resolve technical feasibility issues associated with an electrically regenerable energy storage system satisfying SDI needs. Specifically, energy storage technology will be developed through the proof-of-concept stage within the next six years that provides a specific power greater than 2.5 kW/kg with an energy storage density of at least 450 kJ/kg.

....

87A33793 ISSUE 14 PAGE 2182 CATEGORY 44 87/00/00 3 PAGES UNCLASSIFIED DOCUMENT

UTTL: High capacity nickel-hydrogen cells for space applications

AUTH: A/WARNOCK, D. PAA: A/(USAF, Wright Aeronautical Laboratories, Wright-Patterson AFB, OH)

CIO: UNITED STATES ; IN: Progress in batteries and solar cells. Volume 6 (A87-33776 14-44). Cleveland, OH, JEC Press, Inc., 1987, p. 218-220.

MAJS: /*ELECTRIC POWER/ *FUEL CELLS/ *NICKEL HYDROGEN BATTERIES/ *SPACECRAFT POWER SUPPLIES

MINS: /ANNULI/ DESIGN ANALYSIS/ ELECTRODES/ MILITARY TECHNOLOGY/ SIZE (DIMENSIONS)

ABA: O.C.

ABS: A development status evaluation is presented for nickel-hydrogen batteries intended by the U.S. Air Force for spacecraft uses requiring capacities of up to 300 ampere-hours. These cells use an annular electrode which facilitates heat transfer and allows the electrical leads connecting the electrodes to the terminals to be connected to tabs on the inside perimeter of the electrodes and then routed through the inside of the electrode stack. The smooth circular outer perimeter resulting from this configuration further promotes heat transfer to the pressure vessel across a uniformly narrow gap. A major innovation is the use of catalytic oxygen recombination strips on the inside of the pressure vessel wall.

....

87A33790 ISSUE 14 PAGE 2182 CATEGORY 44 87/00/00 4 PAGES UNCLASSIFIED DOCUMENT

UTTL: Direct fuel cell

AUTH: A/BAKER, B. S. PAA: A/(Energy Research Corp., Danbury, CT)

CIO: UNITED STATES; IN: Progress in batteries and solar cells. Volume 6 (A87-33776 14-44). Cleveland, OH, JEC Press, Inc., 1987, p. 172-175.

MAJS: /*ELECTRIC GENERATORS/ *ENERGY TECHNOLOGY/ *FUEL CELLS/ *METHANE

MINS: /CELL ANODES/ ELECTRIC POWER PLANTS/ ELECTROCHEMISTRY/ ENERGY CONVERSION EFFICIENCY

ABA: O.C.

ABS: An evaluation is made of the development status and performance characteristics of advanced electrical generation systems employing hydrocarbons, especially methane, to directly fuel a molten carbonate fuel cell (MCFC). Methane has been successfully used in multicell stacks; since the effective endothermal conversion of methane to hydrogen is sustained by the stack's waste heat, there is no need to supply further heat through the combustion of the anode exhaust. It is in principle possible to reach 100 percent system efficiency in such a simple, atmospheric pressure MCFC without a bottoming cycle, since there is negligible entropy change for methane oxidation. An electricity output cost of $1300/kW-hr is projected.

....

87A33787* ISSUE 14 PAGE 2182 CATEGORY 44 87/00/00 4 PAGES UNCLASSIFIED DOCUMENT

UTTL: Advanced technology for extended endurance alkaline fuel cells

AUTH: A/SHEIBLEY, D. W.; B/MARTIN, R. A. PAA: A/(NASA, Lewis Research Center, Cleveland, OH); B/(International Fuel Cells Corp., South Windsor, CT)

CORP: National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.; International Fuel Cells Corp., South Windsor, Conn.

CIO: UNITED STATES; IN: Progress in batteries and solar cells. Volume 6 (A87-33776 14-44). Cleveland, OH, JEC Press, Inc., 1987, p. 155-158.

MAJS: /*ALKALINE BATTERIES/ *ENERGY TECHNOLOGY/ *FUEL CELLS/ *SPACE STATION POWER SUPPLIES

MINS: /COST REDUCTION/ ENERGY CONVERSION EFFICIENCY/ SERVICE LIFE/ SOLID ELECTROLYTES/ WEIGHT REDUCTION

ABA: O.C.

ABS: Advanced components have been developed for alkaline fuel cells with a view to the satisfaction of NASA Space Station design requirements for extended endurance. The components include a platinum-on-carbon catalyst anode, a potassium titanate-bonded electrolyte matrix, a lightweight graphite electrolyte reservoir plate, a gold-plated nickel-perforated foil electrode substrate, a polyphenylene sulfide cell edge frame material, and a nonmagnesium cooler concept. When incorporated into the alkaline fuel cell unit, these components are expected to yield regenerative operation in a low earth orbit Space Station with a design life greater than 5 years.

....

87A33778 ISSUE 14 PAGE 2181 CATEGORY 44 87/00/00 5 PAGES UNCLASSIFIED DOCUMENT

UTTL: Material studies on molten carbonate fuel cell

AUTH: A/KODAMA, T. PAA: A/(Osaka, Government Industrial Research Institute, Ikeda, Japan)

CIO: JAPAN; IN: Progress in batteries and solar cells. Volume 6 (A87-33776 14-44). Cleveland, OH, JEC Press, Inc., 1987, p. 7-11.

MAJS: /*CARBONATES/ *ENERGY TECHNOLOGY/ *FUEL CELLS/ *MOLTEN SALT ELECTROLYTES

MINS: /CORROSION TESTS/ METAL SURFACES/ NICKEL ALLOYS/ PHASE DIAGRAMS/ STAINLESS STEELS

ABA: O.C.

ABS: An evaluation is presented for recent test results related to molten carbonate fuel cell binary and ternary electrode and electrolyte matrix materials systems and their physical properties, such as melting point, electrical conductivity, and vapor pressure. Fe- and Ni-based alloys and electrically conductive ceramics for electrodes, and nonconductive or ionically conductive ceramics for electrolytic matrices, have been investigated. Alkaline earth metal carbonates such as CaCO3, BaCO3, and SrCO3 have been added to a conventional LiCO3-K2CO3 binary system in order to reduce corrosiveness.

....

87A15901# ISSUE 4 PAGE 468 CATEGORY 20 RPT#: IAF PAPER 86-153 86/10/00 7 PAGES UNCLASSIFIED DOCUMENT

UTTL: Space power systems for the next decade

AUTH: A/DOUGHERTY, T. A.; B/VAN OMMERING, G.; C/POLLARD, H. E. PAA: C/(Ford Aerospace and Communications Corp., Palo Alto, CA)

CIO: UNITED STATES; IAF, International Astronautical Congress, 37th, Innsbruck, Austria, Oct. 4-11, 1986. 7 p.

MAJS: /*ELECTRIC BATTERIES/ *FUEL CELLS/ *SOLAR ARRAYS/ *SOLAR CELLS/ *SPACECRAFT POWER SUPPLIES

MINS: /ECONOMIC ANALYSIS/ ENERGY STORAGE/ LOW COST/ MANNED SPACECRAFT/ POWER CONDITIONING

....

87A14170 ISSUE 3 PAGE 365 CATEGORY 44 86/08/00 6 PAGES UNCLASSIFIED DOCUMENT

UTTL: Stress and fracture behavior of monolithic fuel cell tapes

AUTH: A/MAJUMDAR, S.; B/CLAAR, T.; C/FLANDERMEYER, B. PAA: C/(Argonne National Laboratory, IL)

CIO: UNITED STATES; American Ceramic Society, Journal (ISSN 0002-7820), 69, Auvol. g. 1986, p. 628-633. DARPA-supported research.

MAJS: / *CERAMICS/ *FRACTURE MECHANICS/ *FUEL CELLS/ *STRESS ANALYSIS

MINS: / COMPOSITE STRUCTURES/ LAMINATES/ STRESS INTENSITY FACTORS/ TAPES/ THERMAL EXPANSION

ABA: Author

ABS: This paper summarizes the stress and fracture analyses of a three-layer ceramic composite which is a fundamental building block for the monolithic solid oxide fuel cell currently being developed at Argonne National Laboratory. A small difference in the coefficients of thermal expansion of different layers can result in large stresses and cause cracking parallel to the plane of the layers. A simple fracture model for a three-layer composite has been developed. The cracking behavior predicted by the model is in reasonably good agreement with the fabrication experience to date.

....

J6X73564# CATEGORY 44 RPT#: TI85-910777 CE-TRANS-7723 82/00/00 31 PAGES UNCLASSIFIED DOCUMENT US GOV AGENCIES AND CONTRACTORS

UTTL: Generation of electricity from hydrogen

AUTH: A/WOJKOWSKY, H.; B/SCHNURNBERGER, W.; C/STERNFELD, H. J.; D/PESCHKE, W.CORP: Central Electricity Generating Board, London (England). MFC: 00

CIO: BELGIUM Transl. into ENGLISH from Int. Seminar Hydrogen as an Energy Vector (Brussels), Feb. 1980 p 547-564

MAJS: /*ELECTRIC GENERATORS/ *FUEL CELLS/ *GAS TURBINES/ *HYDROGEN/ *STEAM TURBINES

MINS: /COMBINED CYCLE POWER GENERATION/ COST EFFECTIVENESS/ ENERGY CONVERSION EFFICIENCY/ ENERGY TECHNOLOGY/ FOSSIL FUELS

....

86X73563# CATEGORY 44 RPT#: AD-B097612L AFWAL-TR-85-2094 CNT#: F33615-83-C-2381 85/12/00 42 PAGES UNCLASSIFIED

DOCUMENT US GOV AGENCIES

UTTL: High energy, high power density sodium/mixed chalcogenide batteries for space power applications; TLSP: Final Report, Jul. 1983 - Apr. 1984

AUTH: A/RASMUSSEN, J. R.

CORP: Ceramatec, Inc., Salt Lake City, Utah. MFC: 00

CIO: UNITED STATES

MAJS: /*AEROSPACE ENGINEERING/ *AEROSPACE SYSTEMS/ *CELL CATHODES/ *CHALCOGENIDES/ *ELECTRIC BATTERIES/ *ELECTRIC POTENTIAL/ *ELECTROLYTIC CELLS/ *FLUX DENSITY/ * SATELLITE TEMPERATURE/ *STORAGE BATTERIES/ *TECHNOLOGY UTILIZATION

MINS: / CIRCUITS/ DEPTH/ ENERGY STORAGE/ OPTIMIZATION/ PHASE DIAGRAMS/ SODIUM/ STRESS RATIO/ SULFUR

....

86X72121# CATEGORY 44 85/02/14 1 PAGES UNCLASSIFIED DOCUMENT US GOV AGENCIES

UTTL: Japan to develop energy-efficient fuel cell

CORP: Joint Publications Research Service, Arlington, Va. MFC: 00 In its Japan Report: Science and Technology (JPRS-JST-85-018-L) p 83 (SEE X86-72101 08-31)

CIO: JAPAN Repr. from Kyodo (Tokyo, Japan), 24 Jan. 1985

MAJS: /*ELECTROCHEMISTRY/ *FUEL CELL POWER PLANTS/ *FUEL CELLS/ *HYDROGEN-BASED ENERGY

MINS: /CARBONATES/ ENERGY CONVERSION EFFICIENCY/ LITHIUM/ SODIUM/ TECHNOLOGY UTILIZATION

....

86X71138# CATEGORY 33 85/04/29 1 PAGES UNCLASSIFIED DOCUMENT US GOV AGENCIES

UTTL: Fuel cell system for use in space test produced

CORP: Joint Publications Research Service, Arlington, Va. MFC: 00 In its Japan Report: Science and Technology (JPRS-JST-85-039-L) p 50 (SEE X86-71135 04-31)

CIO: JAPAN; Repr. from The Japan Economic Journal (Tokyo, Japan), 19 Mar. 1985 p 12

MAJS: /*ELECTRIC GENERATORS/ *ENERGY CONVERSION EFFICIENCY/ *FUEL CELLS/ * SPACECRAFT POWER SUPPLIES

MINS: /AUXILIARY POWER SOURCES/ DIRECT POWER GENERATORS/ ENERGY TECHNOLOGY

....

86X70734# CATEGORY 33 85/08/13 2 PAGES UNCLASSIFIED DOCUMENT US GOV AGENCIES

UTTL: Philips develops battery with hydrogen electrodes

CORP: Joint Publications Research Service, Arlington, Va. MFC: 00 In its West Europe Rept.: Sci. and Technol. (JPRS-WST-85-014-L) p 4-5 (SEE X86-70732 03-31)

TIO: GERMANY, FEDERAL REPUBLIC OF; Transl. into ENGLISH from Elektron. (Munich), 8 Mar. 1985 p 34

MAJS: /*ADSORPTION/ *ELECTROCHEMICAL CELLS/ *HYDROGEN/ *STORAGE BATTERIES

MINS: /ELECTRIC BATTERIES/ ENERGY STORAGE/ RESEARCH AND DEVELOPMENT

....

86N28331# ISSUE 19 PAGE 3033 CATEGORY 33 RPT#: DE86-003188 SAND-85-1446 CNT#: E-AC04-76DP-00789 85/10/00 97 PAGES UNCLASSIFIED DOCUMENT

UTTL: Exploratory battery technology development and testing report for 1984

AUTH: A/MAGNANI, N. J.; B/CLARK, R. P.; C/BUSH, D. M.; D/BUTLER, P. C.; E/CHAMBERLIN, J. L.; F/FREESE, J. M.; G/GROTHAUS, K. R.; H/MURPHY, K. D.; I/SHOEMAKER, P. E.

CORP: Sandia National Labs., Albuquerque, N. Mex. AVAIL.NTIS

SAP: HC A05/MF A01

CIO: UNITED STATES

MAJS: /*ELECTRIC BATTERIES/ *ELECTROCHEMICAL CELLS/ *ENERGY STORAGE/ *FUEL CELLS/ *STORAGE BATTERIES

MINS: /RESEARCH AND DEVELOPMENT/ RESEARCH FACILITIES/ RESEARCH MANAGEMENT

ABA: DOE

ABS: Sandia National Laboratories, Albuquerque, has been designated as Lead Center for the Exploratory Battery Technology Development and Testing Project, which is sponsored by the US Department of Energy's Office of Energy Storage and Distribution. In this capacity, Sandia is responsible for the engineering development of advanced rechargeable batteries for both mobile and stationary energy storage applications. This report details the technical achievements realized in pursuit of the Lead Center's goals during calendar year 1984.

....

86N28329# ISSUE 19 PAGE 3033 CATEGORY 33 RPT#: DE86-003019 CONF-851146-ABST CNT#: DE-AC06-76RL-01830 85/11/00 329 PAGES UNCLASSIFIED DOCUMENT

UTTL: Extended abstracts: Seventh Battery and Electrochemical Contractors' Conference

AUTH: A/SHEPPARD, D.; B/HURWITCH, J. PAT: A/comp.; B/comp.

CORP: Battelle Columbus Labs., Ohio.; Pacific Northwest Labs., Richland, Wash. AVAIL.NTIS

SAP: HC A15/MF A01

CIO: UNITED STATES; Prepared in cooperation with Pacific Northwest Labs., Richland, Wash. Presented at the Annual Battery and Electrochemical Energy Storage Contractors' Meeting, Washington, D.C., 18 Nov. 1985

MAJS: /*CONTRACTORS/ *ELECTRIC BATTERIES/ *ENERGY STORAGE/ *FUEL CELLS/ *TECHNOLOGY TRANSFER

MINS: /ABSTRACTS/ METAL AIR BATTERIES/ SODIUM SULFUR BATTERIES/ SYSTEMS ANALYSIS

ABA: DOE

ABS: Seventy-two papers presented at the Seventh Battery and Electrochemical Contractors' Conference are arranged under the following session headings: EPRI storage program, review of key program activities, sodium/sulfur battery development, advanced battery research (two sessions), flow battery development, sodium/sulfur battery research, systems analysis and technology transfer, performance and testing (two sessions), flow battery research, metal/air batteries, and fuel cells.

....

86N27586# ISSUE 18 PAGE 2899 CATEGORY 33 RPT#: DE86-005529 CONF-860138-2 WCNT#: -31-109-ENG-38 86/00/00 7 PAGES UNCLASSIFIED DOCUMENT

UTTL: Lithium-alloy/iron sulfide batteries

AUTH: A/NELSON, P. A.; B/SHIMOTAKE, H. PAA: B/(Amoco Oil Co., Naperville, Ill.)

CORP: Argonne National Lab., Ill. AVAIL.NTIS

SAP: HC A02/MF A01

CIO: UNITED STATES; Prepared in cooperation with Amoco Research Center, Naperville, Ill. Presented at the International Symposium on Fuel Cell and Advanced Battery, Tokyo, Japan, 22 Jan. 1986

MAJS: /*ELECTRIC BATTERIES/ *ELECTRODES/ *ENERGY STORAGE/ *LITHIUM ALLOYS/ *STORAGE BATTERIES/ *SULFIDES

MINS: /DESIGN ANALYSIS/ ENERGY CONVERSION EFFICIENCY/ LIFE (DURABILITY)

ABA: DOE

ABS: Lithium-alloy/FeS cells with a theoretical capacity of 200 to 400 Ah have been developed. These cells have achieved high specific enegy (100 Whkg), high power (150 Wh/kg), and long life (1000 cycles). Electrode experiments and design studies indicate th possibility of improving specific energy and power by 50 to 100% and, perhaps, retaining cycle

....

86N23047# ISSUE 13 PAGE 2143 CATEGORY 44 RPT#: DE85-018441 CONF-8509154-2 CNT#: W-31-109-ENG-38 85/00/00 3 PAGES UNCLASSIFIED DOCUMENT

UTTL: Post-test analyses of Na/S cells and aqueous batteries

AUTH: A/BATTLES, J. E.; B/SMAGA, J. A.; C/MARR, J. J.

CORP: Argonne National Lab., Ill. AVAIL.NTIS

SAP: HC A02/MF A01

CIO: UNITED STATES; Presented at the International Battery Testing Workshop, Heidelberg, West Germany, 29 Sep. 1985

MAJS: / *FAILURE ANALYSIS/ *FAILURE MODES/ *LEAD ACID BATTERIES/ *NICKEL IRON BATTERIES/ *PERFORMANCE TESTS/ *SODIUM SULFUR BATTERIES

MINS: / ELECTRIC BATTERIES/ ELECTRODES/ INSPECTION/ STORAGE BATTERIES

ABA: DOE

ABS: Post-test examinations are conducted at Argonne National Laboratory to obtain quantitative information on electrode morphology, corrosion and degradation of the cell hardware, and mechanisms responsible for existing or future cell failures. These findings are reported to the organizations responsible for the construction of these cells and support their efforts in achieving improved cell performance, cycle life, and reliability. Results of post-test analyses of recent high-temperature sodium/sulfur cells, and of aqueous lead-acid and nickel/iron batteries are presented. In particular, the relationship between electrode performance and electrode morphology is examined for each of the three battery systems.

....

86N17886# ISSUE 8 PAGE 1307 CATEGORY 44 RPT#: DE85-018177 DOE/CE-0152 185/00/00 4 PAGES UNCLASSIFIED DOCUMENT

UTTL: Electrochemical storage and conversion: Batteries and fuel cells

CORP: Department of Energy, Washington, D. C. AVAIL.NTIS

SAP: HC A02/MF A01

CIO: UNITED STATES

MAJS: /*DESIGN ANALYSIS/ *ELECTRIC BATTERIES/ *RESEARCH AND DEVELOPMENT/ *TECHNOLOGY ASSESSMENT

MINS: /BATTERY CHARGERS/ ELECTROLYSIS/ ELECTROLYTES/ ENERGY CONVERSION/ ENERGY STORAGE/ FUEL CELLS/ TECHNOLOGY UTILIZATION

ABA: DOE

ABS: A brief look at both recent and historical research and development efforts on electric batteries is presented. Both the primary (throw away) and secondary (rechargeable) batteries are investigated. Advanced batteries that will become available in the future are briefly discussed.

....

86N16734# ISSUE 7 PAGE 1127 CATEGORY 44 RPT#: DE85-015241 PNL-5448 CNT#: DE-AC06-76RL-01830 85/06/00 182 PAGES UNCLASSIFIED DOCUMENT

UTTL: Status of the DOE Battery and Electrochemical Technology Program 5

AUTH: A/ROBERTS, R.

CORP: Roberts Consultants, Inc., Chevy Chase, Md. AVAIL.NTIS

SAP: HC A09/MF A01

CIO: UNITED STATES

MAJS: / *ELECTRIC BATTERIES/ *ELECTROCHEMICAL CELLS/ *FUEL CELLS/ *STORAGE BATTERIES

MINS: / LEAD ACID BATTERIES/ METAL AIR BATTERIES/ RESEARCH AND DEVELOPMENT/ ZINC-BROMIDE BATTERIES

ABA: DOE

ABS: The program consists of two activities, Technology Base Research (TBR) managed by the Lawrence Berkeley Laboratory (LBL) and Exploratory Technology Development and Testing (EDT) managed by the Sandia National Laboratories (SNL). The status of the Battery Energy Storage Test (BEST) Facility is presented, including the status of the batteries to be tested. ECS program contributions to the advancement of the lead-acid battery and specific examples of technology transfer from this program are given. The advances during the period December 1982 to June 1984 in the characterization and performance of the lead-acid, iron/nickel-oxide, iron/air, aluminum/air, zinc/bromide, zinc/ferricyanide, and sodium/sulfur batteries and in fuel cells for transport are summarized. Novel techniques and the application of established techniques to the study of electrode processes, especially the electrode/electrolyte interface, are described. Research with the potential of leading to improved ceramic electrolytes and positive electrode container and current-collectors for the sodium/sulfur battery is presented. Advances in the electrocatalysis of the oxygen (air) electrode and the relationship of these advances to the iron/air and aluminum/air batteries and to the fuel cell are noted. The quest for new battery couples and battery materials is reviewed. New developments in the modeling of electrochemical cell and electrode performance with the approaches to test these models are reported.

....

86N16495# ISSUE 7 PAGE 1090 CATEGORY 33 RPT#: DE85-016497 LBL-19545 CNT#: DE-AC03-76F-00098 85/06/23 134 PAGES UNCLASSIFIED DOCUMENT

UTTL: Technology Bae research Project for electrchemical energy storage TLSP: Annual Report, 1984

AUTH: A/KINOSHITA, K. PAT: A/ed.

CORP: California Univ., Berkeley. Lawrence Berkeley Lab. AVAIL.NTIS

SAP: HC A07/MF A01

CIO: UNITED STATES

MAJS: / *ELECTRIC BATTERIES/ *ELECTRIC MOTOR VEHICLES/ *ELECTROCHEMICAL CELL/ *FUEL CELLS/ *STORAGE BATTERIES

MINS: / ELECTROCHEMISTRY/ FEASIBILITY ANALYSIS/ PRODUCT DEVELOPMENT/ TECHNOLOGY UTILIZATION

ABA: DOE

ABS: The DOE Electrochemical Energy Storage Program is divided into two projects: (1) the exploratory technology development and testing (EID) project and (2) the technology base research (TBR) project. The role of the TBR Project is to perform supporting research for the advanced battery systems under development by the EID Project, and to evaluate new systems with potentially superior performance, durability and/or cost characteristics. The specific goal of the TBR Project is to identify the most promising electrochemical technologies and transfer them to industry and/or the EID Project for further development and scale-up. This report summarizes the research, financial, and management activities relevant to the TBR Project in CY 1984. General problem areas addressed by the project include identification of new electrochemical couples for advanced batteries, determination of technical feasibility of the new couples, improvements in battery components and materials, establishment of engineering principles applicable to electrochemical energy storage and conversion, and the assessment of fuel-cell technology for transportation applications. Major emphasis is given to applied research which will lead to superior performance and lower life-cycle costs. The TBR Project is divided into three major project elements: exploratory research, applied science research, and air systems research.

....

86N14764# ISSUE 5 PAGE 800 CATEGORY 44 RPT#: DE85-013910 LBL-19544 CNT#: E-AC03-76SF-00098 85/05/01 22 PAGES UNCLASSIFIED DOCUMENT

UTTL: Technology Base Research Project for electrochemical energy storage TLSP: Executive Summary Report, 1984

AUTH: A/KINOSHITA, K. PAT: A/ed.

CORP: California Univ., Berkeley. Lawrence Berkeley Lab. AVAIL.NTIS

SAP: HC A02/MF A01

CIO: UNITED STATES

MAJS: /*ELECTRIC BATTERIES/ *ELECTRIC MOTOR VEHICLES/ *ELECTROCHEMICAL CELLS

MINS: /ENERGY STORAGE/ ENERGY TECHNOLOGY/ FUEL CELLS/ TECHNOLOGY UTILIZATION

ABA: DOE

ABS: A major goal of this program is to develop electrochemical power sources suitable for application in electric vehicles and/or electric load-leveling devices. The program centers on advanced secondary batteries and fuel cells that offer the potential for high performance and low life-cycle costs. The DOE electrochemical energy storage program is divided into two projects: the exploratory technology development and testing (EID) project and the technology ease research (TBR) project. The specific goal of the TBR project is to identify the most promising electrochemical technologies and transfer them to industry and/or the EID Project for further development and scale-up. The TBR project is divided into three major project elements: Exploratory research, applied science research, and air systems research. Highlights of each project element are summarized.

....

86C12215 RPT#: EIX-86-06-01940 85/00/00 UNCLASSIFIED DOCUMENT DOMESTIC

UTTL: REVIEW OF SPACE POWER TECHNOLOGY.

AUTH: A/LAGHARI, J.R.

PAA: A/ STATE UNIV. OF NEW YORK AT BUFFALO, BUFFALO, NY, USA SAP: 040254 MEHRAN UNIV. RES. J. ENG. TECHNOL; VOL. 4, NO. 4; PP. 29-32; OCT. 1985; ISSN 0254-7821

MAJS: /*FUEL CELLS/ *MILITARY TECHNOLOGY/ *NUCLEAR REACTORS/ *PAYLOADS/ *POWER SUPPLIES/ *SPACE COMMERCIALIZATION/ *SPACE SHUTTLES/ *SPACE TECHNOLOGY EXPERIMENTS/ *SPACE WEAPONS/ *UTILIZATION

ABS: Over the next fifteen years, an increasing number of industrial enterprise and national defense will depend on space-based systems. Power requirements on the space shuttle, which are 10 KW now, may reach up to 375 KW on

the space station within a decade. For military applications, average power approaching 1 MW with pulsed power in excess of 100 MW, may also be required by future space-based weapons by the turn of this century. Costs presently run around $10,000 per kilogram of payload on the shuttle, and therefore, highly efficient, compact and light-weight power components are required for future space applications. To develop and use these high-powered facilities in space, it is estimated that just for the nasa space station alone, the number of shuttle launches per year will increase by at least 4 by 1990, and by 10 through the year 2000. (Edited author abstract) 6 refs.

....

86B10483* CATEGORY 1 MSC-21031 86/11/00 Vol. 10, No. 6, P. 32 UNCLASSIFIED DOCUMENT DOMESTIC

UTTL: Fuel-Cell Structure Prevents Membrane Drying

UNOC: (Embossed plates direct flows of reactants and coolant. Membrane-type fuel-cell battery has improved reactant flow and heat removal. Compact, lightweight battery produces high current and power without drying of membranes.)

AUTH: A/MCELROY, J. PAA: A/(General Electric Co.)

MAJS: / *ELECTRIC BATTERIES/ *FUEL CELLS/ *MEMBRANES

....

86B10277* CATEGORY 7 LEW-14235 86/05/00 Vol. 10, No. 3, P. 118 UNCLASSIFIED DOCUMENT DOMESTIC

UTTL: Thermally-Integrated Fuel-Cell/Electrolyzer Systems

UNOC: (New and more efficient method of thermally integrating fuel cell and electrolyzer designed. Design addresses thermal integration of fuel cell and water electrolyzer in regenerative fuel-cell system. System configuration provides thermal integration with single coolant loop. Configuration does not have thermal limitations associated with trying to transfer heat between two coolant loops. Design less complex and more reliable than prior designs. Adaptable to standalone power systems in conjunction with solar panels for remote-area applications.)

AUTH: A/GAROW, J.; B/MICHAELS, K.; C/MARTIN, R. PAA: A/(United Technologies Corp.); B/(United Technologies Corp.); C/(United Technologies Corp.)

MAJS: /*FUEL CELLS/ *HYDROGEN OXYGEN FUEL CELLS/ *REGENERATIVE FUEL CELLS

....

86A37201/2 86A37201 ISSUE 17 PAGE 2533 CATEGORY 44 85/00/00 598 PAGES UNCLASSIFIED DOCUMENT

UTTL: Solid state batteries; Proceedings of the Advanced Study Institute, Alcabideche, Portugal September 2-4, 1984

AUTH: A/SEQUEIRA, C. A. C.; B/HOOPER, A.

PAA: A/(Lisboa, Universidade Tecnica, Lisbon, Portugal); B/(Atomic Energy Research Establishment, Materials Development Div., Harwell, England) PAT: A/ED.; B/ED.

SAP: $80

CIO: NETHERLANDS; Institute sponsored by NATO, DOE, Army, et al. Dordrecht, Martinus Nijhoff Publisher (NATO ASI Series, No. E101), 1985, 598 p. For individual items see A86-37202 to A86-37221.

MAJS: / *CONFERENCES/ *ENERGY TECHNOLOGY/ *SOLID STATE DEVICES/ *STORAGE BATTERIES

MINS: / COMPOSITE MATERIALS/ DIFFUSION COEFFICIENT/ DIRECT CURRENT/ ELECTRODE MATERIALS/ ELECTRODES/ FRACTALS/ GLASS/ INTERCALATION/ PRIMARY BATTERIES/ SOLID ELECTROLYTES/ SPINEL

ABA: V.L.

ABS: The papers presented in this volume deal with various aspects of current theoretical and experimental research in solid-state batteries. Topics discussed include basic concepts, solid electrolytes, electrode processes and materials, experimental techniques, solid-state batteries, and new technology. Papers are included on

composite materials as solid electrolytes, porous and composite electrodes for solid-state batteries, lithium organic liquid-electrolyte batteries, solid-state rechargeable batteries, and future prospects for all-solid-state batteries.

....

86A36369 ISSUE 16 PAGE 2332 CATEGORY 25 86/03/00 21 PAGES UNCLASSIFIED DOCUMENT

UTTL: Advances in the chemistry of conducting organic polymers - A review

AUTH: A/REYNOLDS, J. R.; PAA: A/(Texas, University, Arlington)

CIO: UNITED STATES Journal of Molecular Electronics (ISSN 0748-7991), vol. 2, Jan.-Mar. 1986, p. 1-21.

MAJS: /*COPOLYMERS/ *ELECTROCHEMISTRY/ *POLYACETYLENE/ *POLYMER CHEMISTRY

MINS: /CELL ANODES/ CELL CATHODES/ COMPOSITE MATERIALS/ ELECTRIC BATTERIES/ ELECTRICAL RESISTIVITY/ ELECTRODES/ FUEL CELLS/ MECHANICAL PROPERTIES/ SOLUBILITY

ABA: Author

ABS: A review covering recent advance in the chemistry of electronically conducting organic polymers is presented. Research directed towards controlling the physical and electronic properties of the systems through structural modification has led to materials having continued improvements in strength, flexibility, elasticity, solubility and stability. Conducting polymers can be obtained from soluble precursor polymers or soluble in the conducting and composite formation has been used to increase the processability of typically intractable materials. Basic studies, comparing a variety of polyheterocycles, have yielded information on the conduction mechanisms and the electronic structure of the conjugated chains. Numerous applications, exemplified here by the use of polyacetylene as a rechargeable battery or catalytic fuel cell electrode, have been explored.

....

86A24845 ISSUE 10 PAGE 1397 CATEGORY 44 85/00/00 8 PAGES UNCLASSIFIED DOCUMENT

UTTL: The mission and status of the U.S. Department of Energy's battery energy storage program

AUTH: A/QUINN, J. E.; B/LANDGREBE, A. R.; C/HURWITCH, J. W.; D/HAUSER, S. G. PAA: B/(DOE, Washington, DC); D/(Battelle Pacific Northwest Laboratories, Richland, WA)

CIO: UNITED STATES; IN: Intersociety Energy Conversion Engineering Conference, 20th, Miami Beach, FL, August 18-23, 1985, Proceedings. Volume 2 (A86-24776 10-44). Warrendale, PA, Society of Automotive Engineers, Inc., 1985, p. 2.3-2.10.

MAJS: /*ENERGY POLICY/ *ENERGY STORAGE/ *RESEARCH PROJECTS/ *STORAGE BATTERIES

MINS: /ELECTROCHEMICAL CELLS/ MARKET RESEARCH/ TECHNOLOGICAL FORECASTING/ TECHNOLOGY TRANSFER

ABA: O.C.

ABS: Attention is given to the U.S. Department of Energy's battery energy storage program history, assessing the importance it has had in the national interest to date in industrial, vehicular, and electric utility load leveling applications. The development status of battery technology is also evaluated for the cases of sodium-sulfur, zinc-bromine, zinc-ferricyanide, nickelhydrogen, aluminum-air, lithium-metal disulfide, and fuel cell systems. Development trends are projected into the foreseeable future.

....

85X76813# CATEGORY 33 RPT#: AD-B092512L AD-E401090 BDM/M-84-0041-TR CNT#: MDA903-84-C-0039 DARPA ORDER 4114 84/09/21 76 PAGES UNCLASSIFIED DOCUMENT US GOV AGENCIES

UTTL: Analysis of electrochemical power sources TLSP: Final Report, 15 Feb. 1984

AUTH: A/GODDARD, T. P.; B/TAGGART, G. B.

CORP: BDM Corp., McLean, Va.

CTO: UNITED STATES

MAJS: /*ALKALINE BATTERIES/ *CAPACITORS/ *CHEMICAL REACTIONS/ *DENSITY/ *DENSITY (MASS/VOLUME)/ *ELECTRIC CHARGE/ *ELECTRICAL PROPERTIES/ *ELECTROLYTES/ * ENERGY STORAGE/ *LIQUIDS/ *LITHIUM/ *SODIUM SULFUR BATTERIES/ *SOLID ELECTROLYTES/ *SOLID STATE DEVICES

MINS: /ELECTRIC POWER SUPPLIES/ ELECTROCHEMICAL CELLS/ POWER/ SOURCES/ STORAGE BATTERIES

....

85X72247# CATEGORY 44 RPT#: AD-B087667L FSTC-HT-821-84 84/09/12 7 PAGES UNCLASSIFIED DOCUMENT US GOV AGENCIES AND CONTRACTORS

UTTL: Fuel cell collector

AUTH: A/VALCHIK, O.; B/PODHAYETSKY, P.

CORP: Army Foreign Science and Technology Center, Charlottesville, Va.

CIO: CZECHOSLOVAKIA; Transl. into ENGLISH from Vestn. Uradu Pro Vynalezy a Objevy (Czechoslovakia), v. 13, no. 9, 1981 p 72

MAJS: /*ACCUMULATORS/ *CONCENTRATORS/ *FUEL CELLS

MINS: /BONDING/ ENERGY TECHNOLOGY/ GRIDS/ PATENTS/ PLATES/ SEALING/ SOLAR COLLECTORS

....

85N71096# CATEGORY 44 RPT#: DE85-003448 DOE/ET-17037-T1-VOL-1 CNT#: E-AI01-80ET-17037 82/08/00 79 PAGES UNCLASSIFIED DOCUMENT

UTTL: USAF requirements analysis of advanced power systems study, volume 1

CORP: Dayton Univ., Ohio. CSS: (School of Engineering.) AVAIL.NTIS

CIO: UNITED STATES

MAJS: /*DIESEL ENGINES/ *ELECTRIC GENERATORS/ *FUEL CELLS/ *GAS TURBINE ENGINES

MINS: /ENERGY TECHNOLOGY/ LIFE CYCLE COSTS/ SPECIFICATIONS/ STIRLING CYCLE

....

85N33588# ISSUE 22 PAGE 3808 CATEGORY 44 RPT#: DE85-009868 ANL/SPG-25 CNT#: -31-109-ENG-38 84/08/00 57 PAGES UNCLASSIFIED DOCUMENT

UTTL: Transfer of battery technology developed by the US Department of Energy

AUTH: A/WALSH, W. J.; B/SYMONS, P. C.

CORP: Argonne National Lab., Ill. AVAIL.NTIS

SAP: HC A04/MF A01

CIO: UNITED STATES

MAJS: /*ELECTRIC BATTERIES/ *FUEL CELLS/ *LEAD ACID BATTERIES/ *LITHIUM SULFUR BATTERIES/ *NICKEL ZINC BATTERIES/ *RESEARCH AND DEVELOPMENT/ *SODIUM SULFUR BATTERIES

MINS: /ENERGY POLICY/ ENERGY STORAGE/ STORAGE BATTERIES/ TECHNOLOGY TRANSFER

ABA: Author

ABS: This study examines linkages between government and the private sector in battery research and development, investigates industry's use of advances in battery technology developed with funding from the US Department of Energy (DOE), and explores the appropriate federal role. A major finding is that industry can promptly and

effectively translate battery advances with commercial potential into new products, and that aggressive technology transfer activities by DOE are unnecessary. Major US battery companies were found to be highly knowledgeable with respect to DOE program content and technological advances attained. In addition, liberal patent waivers have allowed companies to build proprietary positions, and technology diffusion within the private sector can be rapid and efficient. It appears that DOE can best increase the transfer of technology to industry by simply creating advances with commercial potential at a faster rate. Principal recommendations include: (1) an expanded advisory role for industry; (2) increased programmatic flexibility; (3) greater efforts aimed at quantum advances; and (4) increased technical autonomy for industrial contractors.

....

85N31372*# ISSUE 20 PAGE 3443 CATEGORY 33 85/07/00 9 PAGES UNCLASSIFIED DOCUMENT

UTTL: Regenerative fuel cell systems for space station

AUTH: A/HOBERECHT, M. A.; B/SHEIBLEY, D. W.

CORP: National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio. AVAIL.NTIS

SAP: HC A25/MF A01 In NASA. Goddard Space Flight Center The 1984 Goddard Space Flight Center Battery Workshop p 21-29 (SEE N85-31371 20-33)

CIO: UNITED STATES

MAJS: /*AUXILIARY POWER SOURCES/ *ELECTROCATALYSIS/ *ELECTROCHEMISTRY/ *ENERGY STORAGE/ *REGENERATIVE FUEL CELLS/ *SPACE STATIONS/ *STORAGE BATTERIES

MINS: /DIRECT POWER GENERATORS/ ELECTROLYSIS/ ENERGY STORAGE/ SPACECRAFT POWER SUPPLIES/ TECHNOLOGY UTILIZATION

ABA: E.A.K.

ABS: Regenerative fuel cell (RFC) systems are the leading energy storage candidates for Space Station. Key design features are the advanced state of technology readiness and high degree of system level design flexibility. Technology readiness was demonstrated through testing at the single cell, cell stack, mechanical ancillary component, subsystem, and breadboard levels. Design flexibility characteristics include independent sizing of power and energy storage portions of the system, integration of common reactants with other space station systems, and a wide range of various maintenance approaches. The design features led to selection of a RFC system as the sole electrochemical energy storage technology option for the space station advanced development program.

....

85N16292*# ISSUE 7 PAGE 991 CATEGORY 44 RPT#: NASA-CR-174801 NAS 1.26:174801 LSI-TR-376-30 CNT#: NAS3-21287 84/09/00 91 PAGES UNCLASSIFIED DOCUMENT

UTTL: Engineering model system study for a regenerative fuel cell: Study report

AUTH: A/CHANG, B. J.; B/SCHUBERT, F. H.; C/KOVACH, A. J.; D/WYNVEEN, R. A. CORP: Life Systems, Inc., Cleveland, Ohio. AVAIL.NTIS SAP: HC A05/MF A01 C

IO: UNITED STATES

MAJS: /*ELECTROLYSIS/ *ELECTROLYTIC CELLS/ *ENERGY STORAGE/ *ORBITAL SPACE STATIONS/ *REGENERATIVE FUEL CELLS/ *SPACECRAFT POWER SUPPLIES

MINS: /LIFE SUPPORT SYSTEMS/ MATHEMATICAL MODELS/ POTABLE WATER/ STORAGE BATTERIES

ABA: B.A.K.

ABS: Key design issues of the regenerative fuel cell system concept were studied and a design definition of an alkaline electrolyte based engineering model system or low Earth orbit missions was completed. Definition of key design issues for a regenerative fuel cell system include gaseous reactant storage, shared heat exchangers and high pressure pumps. A power flow diagram for the 75 kW initial space station and the impact of different regenerative fuel cell modular sizes on the total 5 year to orbit weight and volume are determined. System characteristics, an isometric drawing, component sizes and mass and energy balances are determined for the 10

kW engineering model system. An open loop regenerative fuel cell concept is considered for integration of the energy storage system with the life support system of the space station. Technical problems and their solutions, pacing technologies and required developments and demonstrations for the regenerative fuel cell system are defined.

....

85N13880*# ISSUE 5 PAGE 608 CATEGORY 20 RPT#: NASA-CP-2352 E-2305 NAS 1.55:2352 84/04/00 322 PAGES UNCLASSIFIED DOCUMENT

UTTL: Space Power

CORP: National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio. AVAIL.NTIS

SAP: HC A14/MF A01

CIO: UNITED STATES; Washington Workshop held in Cleveland, 10-12 Apr. 1984

MAJS: /*CONFERENCES/ *SPACE STATIONS/ *SPACECRAFT POWER SUPPLIES

MINS: /COMMUNICATION SATELLITES/ ELECTROCHEMISTRY/ ENERGY STORAGE/ FLYWHEELS/ GOVERNMENT/ INDUSTRY RELATIONS/ MISSION PLANNING/ PHOTOVOLTAIC EFFECT/ SOLAR ARRAYS/ SPACE POWER REACTORS/ TECHNOLOGY ASSESSMENT/ THERMOELECTRIC GENERATORS

ABA: Appropriate directions for the applied research and technology programs that will develop space power systems for U.S. future space missions beyond 1995 are explored. Spacecraft power supplies; space stations, space power reactors, solar arrays, thermoelectric generators, energy storage, and communication satellites are among the topics discussed. For individual titles see N85-13881 through N85-13909.

....

85N13850*# ISSUE 5 PAGE 604 CATEGORY 20 RPT#: NASA-CP-2346 L-15876 NAS 1.55:2346 84/11/00 419 PAGES UNCLASSIFIED DOCUMENT

UTTL: An Assessment of Integrated Flywheel System Technology

AUTH: A/KECKLER, C. R.; B/BECHTEL, R. T.; C/GROOM, N. J.

PAA: B/(NASA. Marshall Space Flight Center) PAT: A/ed.; B/ed.; C/ed.

CORP: National Aeronautics and Space Administration. Langley Research Center, Hampton, Va. AVAIL.NTIS

SAP: HC A18/MF A01

CIO: UNITED STATES; Washington Workshop held in Huntsville, Ala., 7-9 Feb. 1984

MAJS: / *ATTITUDE CONTROL/ *CONFERENCES/ *ENERGY STORAGE/ *FLYWHEELS/ *INTEGRATED ENERGY SYSTEMS/ *POWER CONDITIONING

MINS: / ENERGY TECHNOLOGY/ POWER SUPPLIES/ TECHNOLOGY ASSESSMENT

ABA: The current state of the technology in flywheel storage systems and ancillary components, the technology in light of future requirements, and technology development needs to rectify these shortfalls were identified. Technology efforts conducted in Europe and in the United States were reviewed. Results of developments in composite material rotors, magnetic suspension systems, motor/generators and electronics, and system dynamics and control were presented. The technology issues for the various disciplines and technology enhancement scenarios are discussed. A summary of the workshop, and conclusions and recommendations are presented. For individual titles see N85-13851 through N85-13879.

....

85A45422 ISSUE 22 PAGE 3301 CATEGORY 44 84/00/00 6 PAGES UNCLASSIFIED DOCUMENT

UTTL: Lithium power sources over the next decade

AUTH: A/BERGER, C.

PAA: A/(U.S. Army, Electronics Technology and Devices Laboratory, Fort Monmouth, NJ)

CIO: UNITED STATES; IN: IECEC '84: Advanced energy systems - Their role in our future; Proceedings of the Nineteenth Intersociety Energy Conversion Engineering Conference, San Francisco, CA, August 19-24, 1984. Volume 1 (A85-45351 22-44). La Grange Park, IL, American Nuclear Society, 1984, p. 518-523.

MAJS: / *BATTERY CHARGERS/ *ELECTRIC BATTERIES/ *ENERGY TECHNOLOGY/ *LITHIUM SULFUR BATTERIES/ *STORAGE BATTERIES

MINS: /ARMED FORCES (UNITED STATES)/ CHARGE EFFICIENCY/ RESEARCH AND DEVELOPMENT/ SULFUR DIOXIDES

ABA: O.C.

ABS: Analytical procedures have been developed for the elucidation of requirements for all new portable battery systems of the U.S. Army. Power supply choice is constrained to a minimum number by means of a carefully defined matrix, which is established on the basis of a multiyear research and development program. Attention is given to lithium battery technology procurement, which constitutes a critical element of the overall program.

....

85A33144* ISSUE 14 PAGE 2006 CATEGORY 20 CNT#: NAG3-359 85/03/00 4 PAGES UNCLASSIFIED DOCUMENT COPYRIGHT

UTTL: A rotating superconducting solenoid for 100 kWh energy storage — in space

AUTH: A/WAYNERT, J.; B/EYSSA, Y. M.; C/MCINTOSH, G. E.; D/FENG, Z. PAA: D/(Wisconsin, University, Madison, WI)

CORP: Wisconsin Univ., Madison.

CIO: UNITED STATES (Applied Superconductivity Conference, Inc., APS, and IEEE, Applied Superconductivity Conference, San Diego, CA, Sept. 10-13, 1984) IEEE Transactions on Magnetics (ISSN 0018-9464), vol. MAG-21, March 1985, p. 664-667.

MAJS: / *ENERGY STORAGE/ *FLYWHEELS/ *SOLENOIDS/ *SPACECRAFT POWER SUPPLIES/ * SUPERCONDUCTORS

MINS: / ASPECT RATIO/ DESIGN ANALYSIS/ EQUIPMENT SPECIFICATIONS/ OPTIMIZATION

ABA: Author

ABS: Two concentric superconducting solenoids, one rotating, the other stationary are analyzed for energy storage in space. Energy is transferred from the rotating mass through a shaft coupled to a motor-generator. The inner windings interact with the magnetic field of the outer solenoid to cancel the centrifugal and self-field forces of the flywheel rim. Current is induced in the inner solenoid thus requiring no separate power supply, while the current in the outer solenoid must vary with the angular velocity of the flywheel. The effect of the gap and scaling laws are developed. The efficiency in energy per unit mass is marginally attractive.

....

85A26700 ISSUE 11 AUG 151 CATEGORY 23 84/0000 1019 PAGES UNCLASSIFIED DOCUMENT

UTTL: Advances in cryogenic engineering materials. Volume 30 Proceedings of the Fifth International Cryogenic Materials Conference, Colorado Springs, CO, August 15-17, 1983

AUTH: A/CLARK, A. F.; B/REED, R. P. PAA: B/(National Bureau of Standards, Boulder, CO) PAT: A/ED.; B/ED. SAP: $95

CIO: UNITED STATES; Conference sponsored by the Institute of Electrical and Electronics Engineers. New York, Plenum Press, 1984, 1019 p. No individual items are abstracted in this volume.

MAJS: / *CONFERENCES/ *CRYOGENICS/ *MATERIALS SCIENCE

MINS: / ACOUSTIC EMISSION/ AUSTENITIC STAINLESS STEELS/ COMPOSITE MATERIALS/ CRACK PROPAGATION/ CREEP PROPERTIES/ ELECTROMAGNETIC PROPERTIES/ FATIGUE TESTS/ GLASS FIBER REINFORCED PLASTICS/ MECHANICAL PROPERTIES/ MICROSTRUCTURE/ MODULUS OF ELASTICITY/ NONDESTRUCTIVE TESTS/ NONFERROUS METALS/ POLYMER MATRIX COMPOSITES/ POWDER METALLURGY/ RADIATION DAMAGE/ SUPERCONDUCTIVITY/ THERMOPHYSICAL PROPERTIES/ WELDING

ABA: C.D.

ABS: A collection of papers on cryogenic materials is presented. The general topic addressed include: composites and polymers, nondestructive inspection, austenitic steels, welding and joining, fatigue and creep, nonferrous alloys, thermophysical properties of materials, and electromagnetic properties of materials. Also considered are: materials for superconducting electronics, microstructure of developmental superconductors, fabrication and optimization of A15 superconductors, mechanical behavior of superconductors, AC behavior of superconductors, and superconductor measurements and stability.

....

85A26501/2 85A26501 ISSUE 11 PAGE 1526 CATEGORY 31 84/00/00 1071 PAGES UNCLASSIFIED DOCUMENT COPYRIGHT

UTTL: Advances in cryogenic engineering. Volume 29 - Proceedings of the Cryogenic Engineering Conference, Colorado Springs, CO, August 15-17, 1983

Auth: A/FAST, R. W.

PAA: A/(Fermi National Accelerator Laboratory, Batavia, IL) PAT: A/ED.

SAP: $95

CIO: UNITED STATES Conference supported by AIRCO, Inc., NBS, NSF, et al. New York, Plenum Press, 1984, 1071 p. For individual items see A85-26502 to A85-26527.

MAJS: / * CONFERENCES/ * CRYOGENIC EQUIPMENT/ * CRYOGENICS

MINS: / CARNOT CYCLE/ COMPRESSORS/ CRYOGENIC FLUID STORAGE/ ELECTRIC POWER SUPPLIES/ HEAT EXCHANGERS/ HEAT TRANSFER/ LIQUEFACTION/ LIQUID NITROGEN/ REFRIGERATORS/ REGENERATORS/ STIRLING CYCLE/ SUPERCONDUCTING MAGNETS/ SUPERCONDUCTIVITY/ THRUST BEARINGS/ TURBINES

ABA: G.R.

ABS: Applications of superconductivity are discussed, taking into account the thermal performance of the MFTF magnets, the design and testing of a large bore superconducting magnet test facility, the development of a 12-tesla multifilamentary Nb3Sn magnet, a superconducting magnet for solid NMR studies, advanced applications of superconductors, transition and recovery of a cyrogenically stable superconductor, and finite-difference modeling of the cryostability of helium II cooled conductor packs. Other topics explored are related to resource availability, heat exchangers, heat transfer to He I, liquid nitrogen, heat transfer in He II, refrigeration for superconducting and cryopump systems, refrigeration of cryogenic systems, refrigeration and liquefaction, dilution and magnetic refrigeration, cryocoolers, refrigeration for space applications, cryogenic applications, cryogenic instrumentation and data acquisition, and properties of fluids. Attention is given to biomedical applications of cryogenics in China, long-term cryogen storage in space, and a passive orbital disconnect strut.

....

85A12599 ISSUE 2 PAGE 183 CATEGORY 44 84/00/00 1075 PAGES UNCLASSIFIED DOCUMENT

UTTL: Handbook of batteries and fuel cells

AUTH: A/LINDEN, D.

PAA: A/(Duracell, Inc., Bethel, CT)

PAT: A/ED.

SAP: $75

CIO: UNITED STATES; New York, McGraw-Hill Book Co., 1984, 1075 p. No individual items are abstracted in this volume.

MAJS: / *ELECTRIC BATTERIES/ *FUEL CELLS/ *PRIMARY BATTERIES/ *STORAGE BATTERIES

MINS: / ALKALINE BATTERIES/ CHARGE EFFICIENCY/ ELECTRICAL PROPERTIES/ ENERGY TECHNOLOGY/ HANDBOOKS/ LEAD ACID

BATTERIES/ LOAD TESTS/ NICKEL CADMIUM BATTERIES/ NICKEL HYDROGEN BATTERIES/ PERFORMANCE TESTS/ VOLT-AMPERE CHARACTERISTICS

ABA: C.D.

ABS: Detailed information is given on the properties, performance characteristics, and applications of all major battery and fuel cell power sources currently being manufactured. The basic concepts, comparative features, and selection criteria that apply to all battery systems are first discussed. Comprehensive coverage is then given to primary batteries, secondary batteries, advanced secondary batteries, reserve and special batteries, and fuel cells.

....

84X75772# CATEGORY 44 RPT#: AD-B081461L FSTC-HT-622-83 83/12/31 7 PAGES UNCLASSIFIED DOCUMENT US GOV AGENCIES

UTTL: Fuel cell power generation

CORP: Army Foreign Science and Technology Center, Charlottesville, Va.

CIO: JAPAN; Transl. into ENGLISH of Japanese patent no. 57-80674, 20 May 1982 3p

MAJS: /*CELL CATHODES/ *CHEMICAL REACTIONS/ *ELECTRIC GENERATORS/ *ELECTROCHEMISTRY / *ELECTROLYTES/ *ENERGY TECHNOLOGY/ *FUEL CELLS/ *HEAT TRANSFER/ *OXIDIZERS

MINS: /CARBONATES/ CELL ANODES/ CHARGE CARRIERS/ ELECTRIC POWER SUPPLIES/ HYDROGEN FUELS/ HYDROGEN IONS/ INVENTIONS/ PATENTS/ RADICALS/ REACTION KINETICS/ THERMOELECTRIC POWER GENERATION

....

84N31535# ISSUE 21 PAGE 3393 CATEGORY 33 RPT#: DE84-012248 LBL-17741 DOCUMENT#: E-AC03-76SF-00098 84/05/11 19 PAGES UNCLASSIFIED DOCUMENT

UTTL: Technology base research project for electrochemical energy storage TLSP: Executive Summary Report, 1983

AUTH: A/KINOSHITA, K. PAT: A/ed.

CORP: California Univ., Berkeley. Lawrence Berkeley Lab. AVAIL.NTIS

SAP: HC A02/MF A01

CIO: UNITED STATES

MAJS: /*ENERGY STORAGE/ *FUEL CELLS/ *METAL AIR BATTERIES/ *SOLID ELECTROLYTES

MINS: /ELECTRIC MOTOR VEHICLES/ ELECTROCHEMICAL CORROSION/ ENERGY TECHNOLOGY/ MOLTEN SALT ELECTROLYTES

ABA: DOE

ABS: The research base in the development of electrochemical technology for electric vehicle and stationary energy storage applications is discussed. The objective of the technology base research (TBR) project is to provide advanced electrochemical systems that satisfy stringent performance and economic requirements for electric vehicle and stationary energy storage applications. The TBR project is divided into four major project elements: electrochemical systems research, supporting research, electrochemical processes, and fuel cells for vehicles. The research, financial and management activities relevant to the TBR project in CY 1983 are summarized. Highlights of each project element are summarized according to the appropriate battery system or electrochemical research area.

....

84N12246*# ISSUE 3 PAGE 346 CATEGORY 20 83/12/00 4 PAGES UNCLASSIFIED DOCUMENT

UTTL: Assessment of potential for batteries in space applications

AUTH: A/FORD, F. E.

CORP: National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md. AVAIL.NTIS

SAP: HC A10/MF A01 In NASA. Langley Research Center Integrated Flywheel Technol., 1983 p 171-174 (SEE N84-12228 03-20)

CIO: UNITED STATES

MAJS: /*DURABILITY/ *ELECTROCHEMISTRY/ *ENERGY STORAGE/ *ENERGY TECHNOLOGY/ *FLUX DENSITY/ *LEAD ACID BATTERIES/ *STORAGE BATTERIES

MINS: /ENERGY DISTRIBUTION/ NICKEL CADMIUM BATTERIES/ SPACE STATIONS/ TECHNOLOGY ASSESSMENT

ABA: E.A.K.

ABS: Different battery technologies for energy storage in space missions were examined. One of the bes ways of the possibilities of high energy density batteries were determined by looking at more conventional batteries (i.e., lead-acid, nickel-cadmium, nickel-hydrogen, etc.).The theoretical specific energy density for state of the art batteries and the usable energy density for reasonable life expectancy are outlined. The most mature of these couples is lead acid, which achieves nearly 20%of its theoretical capacity. The nickel-cadmium couple, has matured to where the active capacity is 17% o its theoretical capacity. The achievements are used to measure the practicality of more advanced batteries and to estimate what is needed for future high power space systems.

....

84N10493# ISSUE 1 PAGE 75 CATEGORY 33 RPT#: DE83-011254 CONF-821211-SUPPL CNT#: DE-AI01-79ET-25204 82/12/00 308 PAGES UNCLASSIFIED DOCUMENT

UTTL: Electrochemical-Storage-Systems Program summary

AUTH: A/KWAN, Q.

CORP: Aerospace Corp., Washington, D. C. AVAIL.NTIS

SAP: HC A14/MF A01

CIO: UNITED STATES; Presented at the 5th DOE Battery and Electrochem. Contr. Conf., Crystal City, Va., 7 Dec. 1982

MAJS: /*ELECTRIC BATTERIES/ *ENERGY STORAGE/ *FUEL CELLS/ *RESEARCH AND DEVELOPMENT

MINS: /BROMIDES/ LEAD ACID BATTERIES/ METAL AIR BATTERIES/ NICKEL IRON BATTERIES/ SODIUM SULFUR BATTERIES/ SOLID ELECTROLYTES/ ZINC

ABA: DOE

ABS: A brief description of each contract and subcontract that was a part of the Electrochemical Energy Storage System (ECS) program through FY 1982 is provided. The work described covers electrochemical systems research, supporting research, electrochemical processes, and fuel cells for transportation, aqueous nonflow batteries, nonaqueous batteries, and battery testing.

....

84A30956 ISSUE 13 PAGE 1927 CATEGORY 44 84/02/00 8 PAGES UNCLASSIFIED DOCUMENT

UTTL: Expected development of chemical power sources

AUTH: A/KULCSAR, S. PAA: A/(Villamosipari Kutato Intezet, Budapest, Hungary)

CIO: HUNGARY Journal of Power Sources (ISSN 0378-7753), vol. 11, Jan.-Feb. 1984, p. 69-76.

MAJS: /*CHEMICAL ENERGY/ *ELECTROCHEMICAL CELLS/ *ENERGY TECHNOLOGY/ *RESEARCH AND DEVELOPMENT

MINS: /ECONOMIC FACTORS/ ELECTRIC BATTERIES/ FUEL CELLS/ TECHNOLOGICAL FORECASTING/ USER REQUIREMENTS

ABA: J.N.

ABS: An investigation of chemical power sources considers their use by professional consumers in terms of

loadability, weight, life, purchase price, operating price, maintenance requirements, and reliability. The criteria for non-professional consumers are mainly purchase price and whether the system is maintenance-free. The single power sources evaluated according to technical requirements, economic properties, convenience, and prognosis include lead-acid accumulators; Ni-Cd accumulators; Ni-Fe accumulators; Ni-Zn accumulators; Ag-Zn accumulators; Zn-Br system accumulators; and accumulators operating at high and average temperatures. Also considered are Leclanchecells; alkali-manganese dioxide cells; elements with Li anode; and fuel cells. It is concluded that present power sources will probably continue to be used for the next 5-10 years, and further development is proposed in various areas, including power supplies for spacecraft and satellites.

....

84A30107 ISSUE 13 PAGE 1849 CATEGORY 20 83/00/00 6 PAGES UNCLASSIFIED DOCUMENT COPYRIGHT

UTTL: Comparative analysis of energy storage systems for space stations

AUTH: A/HSU, L.; B/OPPENHEIM,J. E. PAA: B/(Rockwell International Corp., Shuttle Integration and Satellite Systems Div., Pittsburgh, PA)

CIO: UNITED STATES

IN: IECEC '83; Proceedings of the Eighteenth Intersociety Energy Conversion Engineering Conference, Orlando, FL, August 21-26, 1983. Volume 3 (A84-30102 13-20). New York, American Institute of Chemical Engineers, 1983, p. 957-962.

MAJS: / *ELECTRIC ENERGY STORAGE/ *FUEL CELLS/ *NICKEL HYDROGEN BATTERIES/ *SPACE STATION POWER SUPPLIES/ *SPACE STATIONS/ *SPACECRAFT POWER SUPPLIES/ * TECHNOLOGY ASSESSMENT

MINS: / ENVIRONMENTAL CONTROL/ EVOLUTION (DEVELOPMENT)/ EXPANDABLE STRUCTURES/ LIFE CYCLE COSTS/ LIFE SUPPORT SYSTEMS/ TEMPERATURE CONTROL

ABA: O.C.

ABS: Nickel-hydrogen batteries, open-loop fuel cells, and regenerative fuel cells were subjected to tradeoff analyses, in order to ascertain the optimum evolutionary development approach in the construction sequence of the space station that would employ one of them as an electrical power subsystem (EPS). The analyses extended to all the interfacing subsystems that can be readily integrated with the EPS, such as the environmental control and life support subsystem, the thermal control subsystem, and the reaction control subsystem. Space station evolutionary stage matching with EPSs is notably influenced by new technology, life cycle costs, and space station developmental expansion methods.

....

84A30103 ISSUE 13 PAGE 1849 CATEGORY 20 83/00/00 9 PAGES UNCLASSIFIED DOCUMENT

UTTL: Future military space power systems and technology

AUTH: A/BARTHELEMY, R. R.; B/MASSIE, L. D. PAA: A/(USAF, Space Applications Major Thrust Office, Wright-Patterson AFB, OH); B/(USAF, Wright Aeronautical Laboratories, Wright-Patterson AFB, OH)

CIO: UNITED STATES; IN: IECEC '83; Proceedings of the Eighteenth Intersociety Energy Conversion Engineering Conference, Orlando, FL, August 21-26, 1983. Volume 3 (A84-30102 13-20). New York, American Institute of Chemical Engineers, 1983, p. 932-940.

MAJS: /*ELECTROCHEMICAL CELLS/ *ENERGY STORAGE/ *MILITARY SPACECRAFT/ *SOLAR CELLS / *SPACECRAFT POWER SUPPLIES/ *TECHNOLOGICAL FORECASTING

MINS: /CONCENTRATION/ HIGH VOLTAGES/ INTEGRATED ENERGY SYSTEMS/ PHOTOTHERMAL CONVERSION/ PHOTOVOLTAIC CONVERSION/ POWER CONDITIONING/ POWER CONVERTERS/ SOLAR ARRAYS/ STORAGE BATTERIES/ TECHNOLOGY ASSESSMENT

ABA: O.C.

ABS: Attention is given to the objectives, current status and future directions of U.S. Air Force spacecraft power technology research. These efforts encompass advanced component-, subsystem, and system-level technologies aimed at meeting near-term to mid-term steady state power requirements of the order of 5-30 kW(e). Advanced solar cell, electrochemical energy storage, and high voltage power generation, distribution and power

conditioning technologies are under investigation. Conceptual design efforts and integrated total energy system studies are addressing emerging requirements in the area of pulsed power and burst power systems. The need for novel approaches to thermal control, heat transport and radiative thermal rejection has been recognized, together with the necessity of matching high voltage power conditioning technology to the unique requirements of specialized loads.

....

83N14683*# ISSUE 5 PAGE 703 CATEGORY 44 RPT#: NASA-TM-82940 E-1340 DOE/NASA/12726-18 NAS 1.15:82940 CNT#: DE-AI04-80AL-12726 82/12/00 73 PAGES UNCLASSIFIED DOCUMENT

UTTL: The NASA Redox Storage System Development project, 1980

CORP: National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio. AVAIL.NTIS

SAP: HC A04/MF A01

CIO: UNITED STATES

MAJS: /*ENERGY STORAGE/ *NASA PROGRAMS/ *REDOX CELLS/ *TECHNOLOGY TRANSFER

MINS: /COMMERCIAL ENERGY/ MARKET RESEARCH/ PROJECT PLANNING/ RESEARCH AND DEVELOPMENT

ABA: J.M.S.

ABS: The technical accomplishments pertaining to the development of Redox systems and related technology are outlined in terms of the task elements: prototype systems development, application analyses, and supporting technology. Prototype systems development provides for a major procurement to develop an industrial capability to take the current NASA Lewis technology and go on to the design, development, and commercialization of iron-chromium Redox storage systems. Application analyses provides for the definition of application concepts and technology requirements, specific definition studies, and the identification of market sectors and their penetration potential. Supporting technology includes both in house and contractual efforts that encompass implementation of technology improvements in membranes, electrodes, reactant processing, and system design. The status of all elements is discussed.

....

81N22305# ISSUE 13 PAGE 1755 CATEGORY 33 RPT#: CISE-1589 80/00/00 8 PAGES UNCLASSIFIED DOCUMENT DCAF E070042

UTTL: On AC losses in NbTi and Nb3Al wires — during superconducting power transmission

AUTH: A/ASDENTE, M.; B/CAVALLERI, G.; C/RICCA, A. M.

CORP: Centro Informazioni Studi Esperienze, Milan (Italy). CSS: (Documentation Services.) AVAIL.NTIS

SAP: HC A02/MF A01

CIO: ITALY Sponsored in cooperation with CNR and Ente Nazl. per l'Energia Elettrica Presented at 8th Intern. Cryogenic Eng. Conf. and Exhibition, Genoa, 3-6 Jun. 1980

MAJS: / *ALTERNATING CURRENT/ *NIOBIUM ALLOYS/ *SUPERCONDUCTING POWER TRANSMISSION / *TRANSMISSION LOSS/ *WIRE

MINS: / ALUMINUM ALLOYS/ CRITICAL TEMPERATURE/ ELECTRIC POWER TRANSMISSION/ LOW TEMPERATURE PHYSICS/ SUPERCONDUCTORS/ TITANIUM ALLOYS

ABA: Author (ESA)

ABS: Power losses (ac) in mono and multifilamentary Nb3Al wires with a layered structure and in monofilament NbTi wires were measured by a very sensitive electronic microwattmeter as a function of the effective current I, for temperatures ranging from 4.2 K to T sub C. The power loss P versus current I shows a behavior proportional to Iexp(a). For NbTi there is good agreement with BeanAs model (A = 3) and there is also evidence of a surface current. For Nb3Al, A is 5 at 4.2 K and tends to 3 for T tends to T subc. The multifilamentary Nb3Al wire can carry 200 A at 4.2 K, about three times that of the monofilamentary wire.

....

81K10462 (Sup-004) CNT#: NAG3-170 DUN#: 041188822 CIC#: 2684504 307-01-02 National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio. A/OAST Wisconsin Univ., Madison.

UTTL: Superconductive energy storage for space applications UNCLASSIFIED MARCH 30, 1981 / AUGUST 28, 1982

TM: A/RENZ, D. D. A/5531

PI: B/BOOM, R. W., C/EYSSA, Y. M. REPORTS EXPECTED Former tech. monitors: F. Terdan and I. G. Hansen

MAJS: /*ELECTRIC BATTERIES/ *ELECTRIC ENERGY STORAGE/ *ELECTRIC POWER SUPPLIES/ * ENERGY STORAGE/ *POWER SUPPLY CIRCUITS/ *SPACE FLIGHT/ *SPACECRAFT POWER SUPPLIES/ *STORAGE BATTERIES/ *SUPERCONDUCTIVITY/ *SUPERCONDUCTORS

....

80A20128* ISSUE 6 PAGE 991 CATEGORY 33 CNT#: NASA ORDER A-437018 79/12/00 11 PAGES UNCLASSIFIED DOCUMENT COPYRIGHT

UTTL: Space applications of superconductivity - High field magnets

AUTH: A/FICKETT, F. R. PAA: A/(National Bureau of Standards, Thermophysical Properties Div., Boulder, Colo.)

CORP: National Bureau of Standards, Boulder, Colo.

CIO: UNITED STATES Cryogenics, vol. 19, Dec. 1979, p. 691-701.

MAJS: / *AEROSPACE SYSTEMS/ *ASTRIONICS/ *HIGH FIELD MAGNETS/ *SUPERCONDUCTING MAGNETS/ *TECHNOLOGY UTILIZATION

MINS: / ENERGY STORAGE/ MAGNETIC LEVITATION VEHICLES/ SPACE COMMERCIALIZATION/ SPACECRAFT POWER SUPPLIES/ SPACECRAFT PROPULSION

ABA: V.L.

ABS: The paper discusses developments in superconducting magnets and their applications in space technology. Superconducting magnets are characterized by high fields (to 15T and higher) and high current densities combined with low mass and small size. The superconducting materials and coil design are being improved and new high-strength composites are being used for magnet structural components. Such problems as maintaining low cooling temperatures (near 4 K) for long periods of time and degradation of existing high-field superconductors at low strain levels can be remedied by research and engineering. Some of the proposed space applications of superconducting magnets include: cosmic ray analysis with magnetic spectrometers, energy storage and conversion, energy generation by magnetohydroynamic and thermonuclear fusion techniques, and propulsion. Several operational superconducting magnet systems are detailed.

....

75N24837* ISSUE 16 PAGE 1929 CATEGORY 20 RPT#: NASA-CASE-NPO-13303-1 US-PATENT-3,875,435 US-PATENT-APPL-SN-457295 US-PATENT-CLASS-310-40 US-PATENT-CLASS-310-52 US-PATENT-CLASS-310-10 US-PATENT-CLASS-310-4 US-PATENT-CLASS-60-530 US-PATENT-CLASS-60-516 US-PATENT-CLASS-62-3 US-PATENT-CLASS-62-467 US-PATENT-CLASS-335-216 75/04/01 8 PAGES UNCLASSIFIED DOCUMENT Filed 1 Apr. 194 Supersedes N74-19701 (12 - 11, p 1250)

UTTL: Heat operated cryogenic electrical generator

TLSP: Patent

AUTH: A/WANG, T. G.; B/SAFFREN, M. M.; C/ELLEMAN, D. D. PAA: A/(JPL); B/(JPL); C/(JPL)

PAT: C/inventors (to NASA)

CORP: National Aeronautics and Space Administration. Pasadena Office, Calif.; Jet Propulsion Lab., California Inst. of Tech., Pasadena.

SAP: Avail: US Patent Office

CIO: UNITED STATES Sponsored by NASA

MAJS: / *CRYOGENIC EQUIPMENT/ *ELECTRIC GENERATORS/ *LIQUID HELIUM

MINS: / EQUIPMENT SPECIFICATIONS/ MAGNETIC FIELDS/ PATENTS/ ROTORS/ SUPERCONDUCTING MAGNETS/ SUPERCONDUCTORS

ABA: Official Gazette of the U.S. Patent Office

ABS: An electrical generator useful for providing electrical power in deep space, is disclosed. The electrical generator utilities the unusual hydrodynamic property exhibited by liquid helium as it is converted to and from a superfluid state to cause opposite directions of rotary motion for a roto cell thereof. The physical motion of the rotor cell was employed to move a magnetic field provided by a charged superconductive coil mounted on the exterior of the cell. An electrical conductor was placed in surrounding proximity to the cell to interact with the moving magnetic field provided by the superconductive coil and thereby generate electrical energy. A heat control arrangement was provided for the purpose of causing the liquid helium to be partially converted to and from a superfluid state by being coo

....

1384056 A85-33144 A rotating superconducting solenoid for 100 kWh energy storage (in space) WAYNERT, J.; EYSSA, Y. M.; MCINTOSH, G. E.; FENG, Z. (Wisconsin, University, Madison, WI) Wisconsin Univ., Madison.

Corp. Source Code: W4560409 (Applied Superconductivity Conference, Inc., APS, and IEEE, Applied Superconductivity Conference, San Diego, CA, Sept. 10-13, 1984) IEEE Transactions on Magnetics (ISSN 0018-9464), vol. MAG-21, March 1985, p. 664-667.

Publication Date: Mar. 1985 5 Refs. Contract No.: NAG3-359

Language: English

Country of Origin: United States

Country of Publication: United States

Document Type: JOURNAL ARTICLE; CONFERENCE PAPER; Most documents available from AIAA Technical Library

Journal Announcement: IAA8514

Two concentric superconducting solenoids, one rotating, the other stationary are analyzed for energy storage in space. Energy is transferred from the rotating mass through a shaft coupled to a motor-generator. The inner windings interact with the magnetic field of the outer solenoid to cancel the centrifugal and self-field forces of the flywheel rim. Current is induced in the inner solenoid thus requiring no separate power supply, while the current in the outer solenoid must vary with the angular velocity of the flywheel. The effect of the gap and scaling laws are developed. The efficiency in energy per unit mass is marginally attractive. (Author)

Source of Abstract/Subfile: AIAA/TIS

Descriptors: *ENERGY STORAGE; *FLYWHEELS; *SOLENOIDS; *SPACECRAFT POWER SUPPLIES; *SUPERCONDUCTORS; ASPECT RATIO; DESIGN ANALYSIS; EQUIPMENT SPECIFICATIONS; OPTIMIZATION

Subject Classification: 7520 Spacecraft Propulsion & Power (1975-)

....

No: S1 **Title:** High Strength Lightweight Cryo Tanks

Operations Requirement:

Develop cryo tank designs and materials providing greater leak-proof integrity.

Rationale:

Contemporary propellant plumbing and tankage are leak sensitive and require constant ground operations vigilance. Any configuration simplification has positive consequences on ground support operations.

Sample Concept:

An integral tank containing concentric fuel and oxidizer tanks, (fuel and oxidizer must be thermally compatible), eliminating intertank structure and throughtank plumbing.

Propane and methane are cryogenic fuels that possess potential for common bulkhead concentric tanks. The least expensive propane for instance is well suited for this application because its normal freezing point of -305.8° F allows it to remain liquid at the normal boiling point of oxygen (-297.4° F). Another potential benefit of this concept is the densification by thermal conduction to the oxygen during propellant loading.

Technology Requirement:

1. Research in lightweight, internal insulation, easily applied and reusable without maintenance.
2. Development of innovative alloys retaining higher strength characteristics at cryo temperatures.
3. Development of an integral tank configuration with concentric fuel and oxidizer tanks; made possible by cryo-compatible propellants, i.e., LOX and methane or propane where cryo temperatures and/or fuel freezing point are compatible.

Technology References:

NASA/RECON:

87A33190, 87A13055, 87A13051, 87A13011, 87A11843, 86X75033, 86X74233, 86X73534, 86X10270, 86X10066, 86X10045, 86N22593, 86N13349, 86C12705, 86C00011, 86A40487, 86A36854, 86A36335, 86A31475, 86A31465, 85X74649, 85X10084, 85X10074, 85A46526, 85A45739, 85A43126, 85A41005, 85A39283, 85A37401, 85A37376, 85A35389, 85A27119, 84X73372, 84A34010, 84A32676, 84A28232, 83X72974, 83X72199, 83A37861, 83A33961, 82X73554, 82X71731, 82A47042, 82A38699, 82A24804, 82A23752, 80N30494

87A33190 ISSUE 13 PAGE 2000 CATEGORY 37 85/00/00 6 PAGES UNCLASSIFIED DOCUMENT

UTTL: Automatic tape lamination

AUTH: A/STONE, KIRBY L. PAA: A/(Cincinnati Milacron, Inc., OH)

CIO: UNITED STATES

IN: Advanced composites; Proceedings of the Conference, Dearborn, MI, Dec. 2-4, 1985 (A87-33186 13-24). Metals Park, OH, American Society for Metals, 1985, p. 101-106.

MAJS: / *AUTOMATION/ *FABRICATION/ *FIBER REINFORCED COMPOSITES/ *LAMINATES/ *PANELS / *PLASTIC TAPES

MINS: / CARBON FIBER REINFORCED PLASTICS/ CONTOURS/ GRAPHITE-EPOXY COMPOSITES/ THERMOPLASTIC RESINS/ THERMOSETTING RESINS

ABA: Author

ABS: The increased utilization of advanced composite materials to produce parts having superior strength/weight ratios has resulted in a need for automation in the processing of continuous fiber-reinforced material systems. Automatic tape laminating systems, first developed by aerospace manufacturers, are now commercially available. Automatic tape layers can process continuous fiber thermoset resin systems such as carbon fiber-epoxy systems on flat as well as contoured surfaces. Research on automatic tape layers for thermoplastic resin systems is also being conducted. Most current advanced composite parts are manufactured with heavy reliance on skilled manual labor. Adapting future designs to automatic manufacturing techniques will require consideration of the performance characteristics of automatic tape layers to achieve efficient utilization of this equipment. This paper will review the development of automatic tape layers, and discuss part design considerations when planning for automatic tape lamination.

....

87A13055 ISSUE 3 PAGE 349 CATEGORY 37 86/00/00 9 PAGES UNCLASSIFIED DOCUMENT

UTTL: Material development for automated fabrication

AUTH: A/TERVET, F.; B/BLAD, L. PAA: B/(Lockheed-California Co., Burbank)

CIO: UNITED STATES; IN: International SAMPE Symposium and Exhibition, 31st, Los Angeles, CA, April 7-10, 1986, Proceedings (A87-13051 03-23). Covina, CA, Society for the Advancement of Material and Process Engineering, 1986, p. 58-66.

MAJS: / *AUTOMATION/ *COMPOSITE STRUCTURES/ *FABRICATION/ *MATERIALS SCIENCE

MINS: / CARBON FIBER REINFORCED PLASTICS/ CRACK PROPAGATION/ LAMINATES/ MECHANICAL PROPERTIES/ MOISTURE CONTENT

ABA: O.C.

ABS: Attention is given to composite materials that yield optimum structural properties from automated fabrication and unicure processing, in the case of large composite structures. The two materials presently highlighted are 'Disco', a carbon fiber/epoxy prepreg tape of aligned discontinuous fibers, and 'Filcoat', a carbon fiber/epoxy-filled resin-coated tape. While Disco lends itself to easy production of the complex shapes that are characteristic of subcomponent geometries, Filcoat is dedicated to automated layup processes typical of large structure fabrication.

....

87A13051* ISSUE 3 PAGE 310 CATEGORY 23 86/00/00 1897 PAGES UNCLASSIFIED DOCUMENT

UTTL: International SAMPE Symposium and Exhibition, 31st, Los Angeles, CA, April 7-10, 1986, Proceedings

AUTH: A/BAUER, J. L.; B/DUNAETZ, R. PAA: A/(California Institute of Technology, Jet Propulsion Laboratory, Pasadena); B/(Hughes Aircraft Co., El Segundo, CA) PAT: A/ED.; B/ED.

CORP: Jet Propulsion Lab., California Inst. of Tech., Pasadena.; Hughes Aircraft Co., El Segundo, Calif.

SAP: Members, $50.; nonmembers, $60

CIO: UNITED STATES; Symposium and Exhibition sponsored by the Society for the Advancement of Material and Process Engineering. Covina, CA, Society for the Advancement of Material and Process Engineering (Science of Advanced Materials and Process Engineering Series. Volume 31), 1986, 1897 p. For individual items see A87-13052 to A87-13185.

MAJS: / *CONFERENCES/ *MATERIALS SCIENCE

MINS: / AEROSPACE ENGINEERING/ AIRCRAFT CONSTRUCTION MATERIALS/ ALUMINUM ALLOYS/ COMPOSITE STRUCTURES/ CURING/ EPOXY COMPOUNDS/ EPOXY MATRIX COMPOSITES/ EPOXY RESINS/ FILAMENT WINDING/ GLASS FIBER REINFORCED PLASTICS/ GRAPHITE-EPOXY COMPOSITES/ PREPREGS/ PROCESS CONTROL (INDUSTRY)/ ROBOTICS/ SPACE COMMERCIALIZATION/ SPACE MANUFACTURING/ SPACECRAFT CONSTRUCTION MATERIALS/ STRESS CONCENTRATION

ABA: O.C.

ABS: The present conference on the development status of advanced structural materials considers topics arising in such areas as automated structural manufacturing, advanced material and structure design techniques, environmental effects on materials, composite matrix processing, computer modeling for materials and processes, materials development trends in Europe and in Japan, fiber and whisker reinforcement development status, and novel thermoplastic materials and their applications. Also discussed are pressure-sensitive adhesive systems, materials suitable for space applications, polyimide resin systems, electronic materials, novel resin chemistries, ceramic and metallic systems, and the impact performance of state-of-the-art materials.

....

87A13011# ISSUE 2 PAGE 191 CATEGORY 39 85/00/00 4 PAGES UNCLASSIFIED DOCUMENT

UTTL: Structural design with new materials

AUTH: A/HOSKIN, B. C. PAA: A/(Department of Defence, Aeronautical Research Laboratories, Melbourne, Australia)

CIO: AUSTRALIA; IN: Joint National Symposium on the Influence of Aviation on Engineering and the Future of Aeronautics in Australia, Melbourne, Australia, August 8, 9, 1985, Preprints (A87-13001 02-01). Barton, Australia/Brookfield, VT, Institution of Engineers/Brookfield Publishing Co., 1985, p. 44-47.

MAJS: / *AIRCRAFT CONSTRUCTION MATERIALS/ *AIRCRAFT AIRCRAFT DESIGN/ *MATERIALS/ *PLASTIC FLT STRUCTURES/ *STRUCTURAL DESIGN

MINS: / FATIGUE TESTS/ GRAPHITE-EPOXY COMPOSITES/ IMPACT DAMAGE/ LAMINATES/ STRUCTURAL ANALYSIS/ STRUCTURAL STRAIN

ABA: O.C.

ABS: Attention is given to the development status of the advanced structural design methods which complement state-of-the-art lightweight materials' use in aircraft primary structures. The ways in which the introduction of fiber-reinforced polymer matrix composites has affected airframe structure design and analysis procedures are characterized. Attention is given to single-ply mechanics, symmetric, orthotropic and quasi-orthotropic laminate properties, the laminate stress-strain law, and such in-service composite structure factors as environmental effects, near-invisible impact damage, and fatigue.

....

87A11843 ISSUE 2 PAGE 185 CATEGORY 37 86/07/00 8 PAGES UNCLASSIFIED DOCUMENT

UTTL: Automatically woven three-directional composite structures

AUTH: A/BRUNO, P. S.; B/KEITH, D. O.; C/VICARIO, A. A., JR. PAA: C/(Hercules Aerospace Co., Magna, UT)

CIO: UNITED STATES; SAMPE Quarterly (ISSN 0036-0821), vol. 17, July p. 101986, -17.

MAJS: / *AUTOMATION/ *COMPOSITE WRAPPING/ *FIBER REINFORCED COMPOSITES/ *WEAVING

MINS: / AIRCRAFT STRUCTURES/ CARBON FIBER REINFORCED PLASTICS/ CARBON-CARBON COMPOSITES/ EXHAUST NOZZLES/ FUEL TANKS/ THREE DIMENSIONAL COMPOSITES

ABA: Author

ABS: Three-directional (3-D) fiber reinforced composites were demonstrated with advantages for certain missile and space structures. The applications range from carbon-carbon (c-c) to carbon-epoxy structures. Three-D carbon fiber preforms were woven using automated techniques developed by Aerospatiale of France and then impregnated and processed into c-c or carbon-epoxy structures. Demonstrated structures include c-c ITEs and exit cones for rocket nozzles and carbon-epoxy adapter rings for rocket cases. Other potential applications, including satellite truss joints and meteoroid impact shields for Space Station components, are identified. Advantages of these structures include automated fabrication, improved mechanical properties, and greater reliability.

....

86X75033 CATEGORY 26 RPT#: AD-B098403L FTD-ID(RS)T-0930-85 85/12/31 315 PAGES UNCLASSIFIED DOCUMENT US GOV AGENCIES

UTTL: The 11th Conference on Special Steels and Alloys in Aeronautics

AUTH: A/ODORICO, J.

CORP: Air Force Systems Command, Wright-Patterson AFB, Ohio. CSS: (Foreign Technology Div.) MFC: 00

CIO: U.S.S.R. Conference held in Le Bourget, France, 6 Jun. 1985 Transl. into ENGLISH from Aciers et Metaux Speciaux Aviation (France), 6 Jun. 1985 p 1-236

MAJS: / *AEROSPACE SYSTEMS/ *AIRFRAME MATERIALS/ *ALUMINUM ALLOYS/ *COMPOSITE MATERIALS/ *HELICOPTERS/ *HIGH STRENGTH STEELS/ *LANDING GEAR/ *MISSILE STRUCTURES/ *SINGLE CRYSTALS/ *STEEL STRUCTURES/ *THRUST REVERSAL/ *TITANIUM ALLOYS/ *TURBINE BLADES

MINS: /AIRCRAFT CONSTRUCTION MATERIALS /CONFERENCES /STRUCTURAL MEMBERS

....

86X74233# CATEGORY 24 RPT#: AD-B098512 CPIA-PUBL-431 CNT#: N00024-85-C-5301 85/08/00 453 PAGES UNCLASSIFIED DOCUMENT US GOV AGENCIES AND CONTRACTORS

UTTL: Composite Overwrapped Metal Lined Pressure Vessels. OMCS Workshop

AUTH: A/SIMMONS, L. D. PAT: A/ed.

CORP: Johns Hopkins Univ., Laurel, Md. CSS: (Chemical Propulsion Information Agency.)

SAP: Limited by ITAR MFC: 00

CIO: UNITED STATES; Workshop held in El Segundo, Calif., 27-29 Aug. 1985

MAJS: / *COMPOSITE WRAPPING/ *CONFERENCES/ *LININGS/ *METAL FINISHING/ *PRESSURE VESSELS/ *PROPELLANT STORAGE/ *STORAGE TANKS/ *SURFACE LAYERS

MINS: / COMPOSITE MATERIALS/ DESIGN ANALYSIS/ INSULATION/ MANUFACTURING/ PERFORMANCE TESTS/ SURFACE FINISHING

....

86X73534# CATEGORY 38 RPT#: AD-B096263L UDRI-TR-85-33 AFWAL-TR-85-4059 CNT#: F33615-82-C-5039 85/05/00 112 PAGES UNCLASSIFIED DOCUMENT US GOV AGENCIES

UTTL: ORC evaluation of materials and processes TLSP: Final Report, 15 Jun. 1982 - 14 Feb. 1985

AUTH: A/ASKINS, D. R.; B/CERVAY, R. R.; C/FULTZ, G. W.; D/HART, D. L.; E/HURLEY, C. J.

CORP: Dayton Univ., Ohio. CSS: (Research Inst.) MFC: 00

CIO: UNITED STATES

MAJS: / *ADHESIVES/ *AEROSPACE ENVIRONMENTS/ *AIRCRAFT EQUIPMENT/ *ALUMINUM ALLOYS/ *BLADDER/ *CARBON-CARBON COMPOSITES/ *CIRCUITS/ *COMPOSITE MATERIALS/ * CORROSION RESISTANCE/ *CRACK PROPAGATION/ *CRACKING (FRACTURING)/ *DAMAGE/ * DECOMPOSITION/ *DRONE AIRCRAFT/ *ELASTOMERS/ *ELECTRONIC EQUIPMENT/ *EROSION/ *EXTRUDING/ *FATIGUE (MATERIALS)/ *FLAME STABILITY/ *FUEL TANKS/ *GASKETS/ * GREASES/ *HIGH TEMPERATURE

LUBRICANTS/ *HOSES/ *HYDRAULIC FLUIDS/ *HYDROLYSIS / *INFRARED SUPPRESSION/ *INSULATION/ *LASER STABILITY/ *MANUFACTURING/ * MECHANICAL PROPERTIES/ *METAL FOAMS/ *METAL FUELS/ *O RING SEALS/ *PLASTICS/ * POLYIMIDE RESINS/ *POLYMERIC FILMS/ *POLYPROPYLENE/ *PORTABLE EQUIPMENT/ * SEALERS/ *SHELTERS/ *THERMAL CONTROL COATINGS/ *THERMODYNAMIC PROPERTIES/ * TIMING DEVICES/ *TRANSPARENCE/ *TURBINE BLADES/ *WIND TUNNELS/ *WIRE

MINS: / ADHESIVES/ COMPATIBILITY/ DATA ACQUISITION/ DRONE VEHICLES/ FAILURE/ MAINTENANCE/ PRINTED CIRCUITS/ RATES (PER TIME)/ REQUIREMENTS/ SPECIFICATIONS/ TOLERANCES (MECHANICS)

....

86X10270* ISSUE 8 CATEGORY 1 RPT#: NASA-SP-7058 NAS 1.21:7058 86/06/00 324 PAGES UNCLASSIFIED DOCUMENT US GOV AGENCIES AND CONTRACTORS

UTTL: European aeronautics and astronautics: A bibliography with indexes

CORP: National Aeronautics and Space Administration, Washington, D.C.

MFC: 00

MAJS: / *AERONAUTICAL ENGINEERING/ *AEROSPACE ENGINEERING/ *ASTRONAUTICS/ *BIBLIOGRAPHIES

MINS: / AEROSPACE MEDICINE/ AIRCRAFT CONSTRUCTION MATERIALS/ AIRCRAFT DESIGN/ AIRCRAFT ENGINES/ AVIONICS/ EUROPE/ SPACE EXPLORATION/ SPACECRAFT CONSTRUCTION MATERIALS/ SPACECRAFT DESIGN/ SPACECRAFT PROPULSION/ TELECOMMUNICATION

ABA: M.G.

ABS: This bibliography contains 1433 annotated references to reports and journal articles of European intellectual origin entered into the NASA scientific and technical information database during 1985. Representative subject areas include: aerodynamics, aircraft design and instrumentation, aerospace materials, communications, spacecraft design and related engineering, natural space sciences, and aerospace medicine.

....

86X10066*# ISSUE 2 CATEGORY 24 85/12/00 12 PAGES UNCLASSIFIED DOCUMENT DOMESTIC RM

UTTL: Effects of thermal cycling on thermal expansion and mechanical properties of advanced carbon-carbon composites

AUTH: A/OHLHORST, C. W.; B/RANSONE, P. O.

CORP: National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

SAP: Limited by ITAR MFC: 00 In its Metal Matrix, Carbon, and Ceramic Matrix Composites 1985 p 277-288 (SEE X86-10045 02-24)

CIO: UNITED STATES

MAJS: / *CARBON FIBERS/ *CARBON-CARBON COMPOSITES/ *TEMPERATURE EFFECTS/ *THERMAL CONTROL COATINGS/ *THERMAL EXPANSION/ *THERMAL PROTECTION

MINS: / PYROLYSIS/ SHEAR STRENGTH/ SPACE SHUTTLE ORBITERS/ SPACECRAFT CONSTRUCTION MATERIALS/ VACUUM

ABA: Author

ABS: Uncoated advanced carbon-carbon (ACC) was exposed to coating and mission-temperature cycles in a vacuum to assess the effect of thermal history on interlaminar properties. Interlaminar shear and out-of-plane tensile strengths are measured at room temperature for cycled and uncycled material. Through-the-thickness thermal expansion from room temperature to 2800 degrees F was also determined. Out-of-plane tensile and interlaminar shear strengths are not degraded by thermal cycling in vacuum. Through-the-thickness thermal expansion of uncoated ACC is not stable as densified due to incomplete pyrolysis of the matrix resin.

....

86X10045*# ISSUE 2 CATEGORY 24 RPT#: NASA-CP-2406 L-16072 NAS 1.55:2406 85/12/00 334 PAGES UNCLASSIFIED DOCUMENT DOMESTIC

UTTL: Metal Matrix, Carbon, and Ceramic Matrix Composites 1985

AUTH: A/BUCKLEY, J. D. PAT: A/ed.

CORP: National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

SAP: Limited by ITAR MFC: K4

CIO: UNITED STATES; Conference held in Cocoa Beach, Fla., 23-25 Jan. 1985; sponsored by NASA and DOD

MAJS: / *CARBON FIBERS/ *CARBON-CARBON COMPOSITES/ *CERAMIC MATRIX COMPOSITES/ * CONFERENCES/ *FIBER COMPOSITES/ *MATRIX MATERIALS/ *METAL MATRIX COMPOSITES/ * POWDER METALLURGY/ *PROCESS CONTROL (INDUSTRY)/ *SILICON CARBIDES/ *THERMAL CONTROL COATINGS

MINS: / AIRFRAME MATERIALS/ ALUMINUM/ BORON FIBERS/ BOROSILICATE GLASS/ COMPOSITE STRUCTURES/ DECOMPOSITION/ FABRICATION/ FABRICS/ GAS TURBINE ENGINES/ HOT PRESSING/ MANUFACTURING/ MECHANICAL PROPERTIES/ METAL POWDER/ MULLITES/ OXIDATION RESISTANCE/ PANELS/ PYROLYSIS/ RESINS/ SPACECRAFT CONSTRUCTION MATERIALS/ VAPOR DEPOSITION/ WHISKERS (CRYSTALS)

ANN: The processing of the joint NASA/DOD Conference on Metal Matrix, Carbon, and Ceramic Matrix Composites, held at Cocoa Beach, Florida, on January 23 to 25, 1985, are reported. The purpose of the conference was to present technology related to the manufacture and fabrication techniques of metal matrix, carbon, and ceramic matrix composites. An assessment of ceramic fiber coating effects on ceramic fiber composites, silicon carbide whisker reinforced glass and ceramics, and the use of carbon-carbon composites for advanced spacecraft are among the topics discussed.

....

86N22593# ISSUE 13 PAGE 2074 CATEGORY 18 RPT#: ESA-SP-232 ISSN-0379-6566 85/11/00 293 PAGES UNCLASSIFIED DOCUMENT DCAF E003091

UTTL: Proceedings of Third European Symposium on Spacecraft Materials in Space Environment

AUTH: A/GUYENNE, T. D.; B/HUNT, J. J. PAT: A/comp.; B/comp.

CORP: European Space Agency, Paris (France). AVAIL.NTIS

SAP: HC A13/MF A01

CIO: FRANCE; Symposium held in Noordwijk, Netherlands, 1-4 Oct. 1985; sponsored by ESA, CNES, and Centre d'Etudes et de Recherches de Toulouse

MAJS: / *AEROSPACE ENVIRONMENTS/ *CONFERENCES/ *SPACECRAFT CONSTRUCTION MATERIALS

MINS: / COMPOSITE MATERIALS/ SPACE COMMERCIALIZATION/ SPACE ENVIRONMENT SIMULATION/ SPACECRAFT CHARGING/ SPACECRAFT CONTAMINATION/ SPACECRAFT STRUCTURES/ THERMAL CONTROL COATINGS

ANN: Spacecraft contamination; material behavior in low orbit; spacecraft charging; composite materials; and thermal control materials were discussed. For individual titles see N86-22594 through N86-22626.

....

86N13349*# ISSUE 4 PAGE 558 CATEGORY 16 RPT#: NASA-TM-87626 NAS 1.15:87626 85/10/00 30 PAGES UNCLASSIFIED DOCUMENT

UTTL: Structures and materials technology issues for reusable launch vehicles

AUTH: A/DIXON, S. C.; B/TENNEY, D. R.; C/RUMMLER, D. R.; D/WIETING, A. R.; E/BADER, R. M. PAA: E/(AFWAL, Dayton, Ohio)

CORP: Natonal Aeronautics and Space Administration. Langley Research Center, Hampton, Va. AVAIL.NTIS

SAP: HC A03/MF A01

CIO: UNITED STATES; Presented at the EASCON 85 18th Ann. Electron. and Aerospace Systems Conf., Washington, D.C., 28-30 Oct. 1985

MAJS: / *AIRFRAMES/ *COMPOSITE MATERIALS/ *DYNAMIC LOADS/ *HYPERSONIC VEHICLES/ * REUSABLE LAUNCH VEHICLES/ *SYSTEMS ANALYSIS/ *WEIGHT REDUCTION

MINS: / AEROTHERMODYNAMICS/ AIR BREATHING BOOSTERS/ COST REDUCTION/ CRYOGENIC FLUID STORAGE/ HEAT TRANSFER/ REFRACTORY MATERIALS/ SATELLITE LIFETIME/ THERMAL PROTECTION

ABA: Author

ABS: Project space missions for both civil and defense needs require significant improvements in structures and materials technology for reusable launch vehicles: reductions in structural eight compared to the Space Shuttle Orbiter of up to 25% or more, a possible factor of 5 or more increase in mission life, increases in maximum set temperature of the external surface, reusable containment of cryogenic hydrogen and oxygen, significant reductions in operational costs,and possibly less lead time between technology readiness and initial operational capability. In addition, there is increasing interest in hypersonic airbreathing propulsion for launch and transmospheric vehicles, and such systems require regeneratively cooled structure. The technology issues are addressed, giving brief assessments of the state-of-the-art and proposed activities to meet the technology requirements in a timely manner.

....

86C12705 RPT#: EIX-85-11-09920 85/00/00 UNCLASSIFIED DOCUMENT DOMESTIC

UTTL: AEROSPACE COMPOSITES.

AUTH: A/ENGLISH, LAWRENCE K. PAA: A/MATERIALS ENGINEERING, CLEVELAND, OH, USA

SAP: 096479 MATER ENG. (CLEVELAND); VOL. 102, NO. 4; PP. 32-36; SEP. 1985; ISSN 0025-5319

MAJS: / *AEROSPACE ENGINEERING/ *COMPOSITE MATERIALS/ *MATERIALS/ *MATERIALS SCIENCE / *SPACE COMMERCIALIZATION/ *SPACE SHUTTLES/ *UTILIZATIONS

ABS: The working environments of aircraft, spacecraft, and low earth orbiters pose unique mechanical thermal/radiative, acoustic, and other stresses. This article discusses how and which composites appear to be the material of the future for these demanding applications. Subjects covered include reinforcements, matrix resins, the special needs of design for space, and applications in the space shuttle.

....

86C00011 RPT#: INS-PHA-86-073465-EEA-86-040389 85/00/00 UNCLASSIFIED DOCUMENT DOMESTIC

UTTL: Third European Symposium on spacecraft materials in space environment (ESA SP-232).

UNCC: Third European Symposium on Spacecraft Materials in Space Environment; Noordwijk, Netherlands; 1-4 oct. 1985 nov. 1985; 285P.; VOL. VIII

MAJS: / *AEROSPACE ENVIRONMENTS/ *CHARGING/ *COMPOSITE MATERIALS/ *CONFERENCES/ * CONTAMINATION/ *DISCHARGE/ *EUROPEAN SPACE AGENCY/ *MATERIALS/ *SPACE/ *SPACE COMMERCIALIZATION/ *SPACECRAFT/ *THERMAL CONTROL COATINGS

ABS: The following topics were dealt with: contamination; materials in low orbit; charging-up and discharges; composite materials; advanced materials and applications; and, thermal control materials.

....

86A40487 ISSUE 19 PAGE 2751 CATEGORY 24 85/00/00 307 PAGES
UNCLASSIFIED DOCUMENT

UTTL: Carbon fibers and their composites

AUTH: A/FITZER, E. PAA: A/(Karlsruhe, Universitaet, West Germany) PAT: A/ED.SAP: $58

CIO: GERMANY, FEDERAL REPUBLIC OF; Berlin and New York, Springer-Verlag, 1985, 307 p. For individual items see A86-40488 to A86-40499.

MAJS: / *CARBON FIBER REINFORCED PLASTICS/ *COMPOSITE MATERIALS/ *CONFERENCES/ * TECHNOLOGY ASSESSMENT

MINS: / AIRCRAFT CONSTRUCTION MATERIALS/ FABRICATION/ FIBER STRENGTH/ LAMINATES/ MEDICAL EQUIPMENT/ OPTIMIZATION/

POLYMER MATRIX COMPOSITES/ PROCESS CONTROL (INDUSTRY)/ PRODUCTION ENGINEERING/ QUALITAY CONTROL/ RESIN MATRIX COMPOSITES/ SPACECRAFT CONSTRUCTION MATERIALS/ SYSTEMS ENGINEERING/ TECHNOLOGY UTILIZATION

ABA: O.C.

ABS: The present conference considers topics encompassing the fields of advanced composite reinforcing fibers, polymeric matrices, fabrication and design methodologies for carbon fiber-reinforced composites (CFRPs), the testing and fracture behavior of CFRPs, CFRP applications in aerospace, and the R&D activities in carbon fiber production of Brazil, India, China, and South Korea. Specific discussions are presented concerning the effect of matrix resin choice on prepreg processing, the development of thermosetting polyimide matrix resins, autoclave compression molding, design preparations for large space structures, CFRP testing and properties optimization, industrial and marine applications of carbon fiber reinforcements, and biomedical application of CFRP.

....

86A36854# ISSUE 16 PAGE 2368 CATEGORY 39 85/00/00 7 PAGES UNCLASSIFIED DOCUMENT

UTTL: A prototype expert system for the design and analysis of composite material structures

AUTH: A/ZUMSTEG, J. R.; B/PECORA, D.; C/PECORA, V. J. PAA: B/(Lockheed Advanced Software Laboratory, Palo Alto, CA); C/(Quintus Computer Systems, Palo Alto, CA) CIO: UNITED STATES

IN: Computers in engineering 1985; Proceedings of the International Computers in Engineering Conference and Exhibition, Boston, MA, August 4-8, 1985. Volume 2 (A86-36851 16-31). New York, American Society of Mechanical Engineers, 1985, p. 137-143.

MAJS: / *COMPOSITE STRUCTURES/ *COMPUTER AIDED DESIGN/ *EXPERT SYSTEMS/ *STRUCTURAL ANALYSIS/ *STRUCTURAL DESIGN

MINS: / LAMINATES/ MECHANICAL PROPERTIES/ NOMENCLATURES/ PROTOTYPES/ RULES

ABA: Author

ABS: The development of the Composites Design Assistant, a prototype expert system for aerospace structural engineering, is described. Using a PROLOG-based backward-chaining expert system framework together with rules incorporating knowledge about sandwich panel design and analysis, the prototype system functions as an assistant to the engineer during the design process. The expert system coordinates access to a database manager for material properties, and to a laminate analysis code for computation of the effective elastic properties of composite laminates. Several software issues encountered during the development of the system are discussed, and an example of the application of the system to a sandwich panel design is described.

....

86A36335 ISSUE 16 PAGE 2329 CATEGORY 23 86/04/00 7 PAGES UNCLASSIFIED DOCUMENT

UTTL: Structural materials in aeronautics - Prospects and perspectives

AUTH: A/POPE, G. G. PAA: A/(Royal Aircraft Establishment, Farnborough, England)

CIO: UNITED KINGDOM Aerospace (UK) (ISSN 0305-0831), vol. 13, April 1986, p. 16-22.

MAJS: / *AIRCRAFT CONSTRUCTION MATERIALS/ *AIRCRAFT STRUCTURES

MINS: / ALUMINUM ALLOYS/ CARBON FIBER REINFORCED PLASTICS/ ENGINE PARTS/ FATIGUE (MATERIALS)/ LIFE CYCLE COSTS/ STEEL/ TITANIUM ALLOYS/ WEIGH REDUCTION

ABA: M.S.K.

ABS: The factors influencing choices of materials for aircraft components are reviewed, along with reentry advances in available materials and their applications. The primary concern is weight minimization, followed by maximized strength and stiffness, acceptable life cycle costs and fatigue resistance. The operational environment is of concern, especially near oceans due to corrosion for metals (which can be coated)and weakening of composites (due to water absorption). New aircraft propulsion system designs continually require higher operating temperatures with the concomitant desire for long-life materials. The features, performance and present and projected applications of various composites, Ti alloys, steels and Al alloys, particularly for

military purposes, are examined.

....

86A31475 ISSUE 13 PAGE 1812 CATEGORY 23 85/00/00 376 PAGES UNCLASSIFIED DOCUMENT

UTTL: Materials and processes; Proceedings of the Fifth Technology Conference, Montreux, Switzerland, June 12-14, 1984. Volumes 1&2

SAP: Price of two volumes, $51

CIO: SWITZERLAND; Conference sponsored by the Society for the Advancement of Material and Process Engineering. Geneva, Switzerland, Society for the Advancement of Material and Process Engineering, 1985. Vol. 1, 185 p.; vol. 2, 191 p. No individual items are abstracted in these volumes.

MAJS: / *COMPOSITE MATERIALS/ *CONFERENCES/ *MATERIALS SCIENCE

MINS: / AIRCRAFT CONSTRUCTION MATERIALS/ ALUMINUM ALLOYS/ AUTOMOBILE ENGINES/ CARBON FIBER REINFORCED PLASTICS/ FIBER REINFORCED COMPOSITES/ FILAMENT WINDING/ GLASS FIBER REINFORCED PLASTICS/ GRAPHITE-EPOXY COMPOSITES/ HELICOPTER TAIL ROTORS/ KEVLAR (TRADEMARK)/ MATRIX MATERIALS/ METAL MATRIX COMPOSITES/ METALLIZING/ MOISTURE CONTENT/ POLYMER MATRIX COMPOSITES/ SUPERPLASTICITY/ TEXTILES/ THERMOPLASTIC RESINS/ TITANIUM ALLOYS

ABA: O.C.

ABS: The present conference on advanced aerospace materials gives attention to high performance thermoplastic matrix composites and their manufacturing techniques, the filament winding of complex components, the mechanized manufacturer of FRP components for aircraft secondary, a novel high strain-to-failure prepreg, the manufacture of accurate glass and carbon fiber preforms for resin injection, a helicopter composite tail unit, Al-Li alloys, the durability of Arall, the potential weight savings obtainable in future transport aircraft through the use of advanced materials, superplastically formed Ti and Al alloys for aerospace applications, and assembly bonding with room temperature-curing adhesives. Also discussed are novel composite systems for use in primary aircraft structures, accelerated moisture absorption in carbon-epoxy, the thermoanalytic characterization of matrix resins and composites, the definition of microstructures in hybrid reinforced plastics, ceramic components for automotive powerplants, Kevlar-reinforced automotive components, metallized textile fabrics and their applications, and the role of S-2 glass fibers in advanced composites.

....

86A31465 ISSUE 13 PAGE 1812 CATEGORY 23 85/00/00 376 PAGES UNCLASSIFIED DOCUMENT

UTTL: Materials and processes; Proceedings of the Fifth Technology Conference, Montreux, Switzerland, June 12-14, 1984. Volumes 1&2

SAP: Price of two volumes, $51

CIO: SWITZERLAND: Conference sponsored by the Society for the Advancement of Material and Process Engineering. Geneva, Switzerland, Society for the Advancement of Material and Process Engineering, 1985. Vol. 1, 185 p.; vol. 2, 191 p. No individual items are abstracted in these volumes.

MAJS: / *COMPOSITE MATERIALS/ *CONFERENCES/ *MATERIALS SCIENCE

MINS: /AIRCRAFT CONSTRUCTION MATERIALS/ ALUMINUM ALLOYS/ AUTOMOBILE ENGINES/ CARBON FIBER REINFORCED PLASTICS/ FIBER REINFORCED COMPOSITES/ FILAMENT WINDING/ GLASS FIBER REINFORCED PLASTICS/ GRAPHITE-EPOXY COMPOSITES/ HELICOPTER TAIL ROTORS/ KEVLAR (TRADEMARK)/ MATRIX MATERIALS/ METAL MATRIX COMPOSITES/ METALLIZING/ MOISTURE CONTENT/ POLYMER MATRIX COMPOSITES/ SUPERPLASTICITY/ TEXTILES/ THERMOPLASTIC RESINS/ TITANIUM ALLOYS

ABA: O.C.

ABS: The present conference on advanced aerospace materials gives attention to high performance thermoplastic matrix composites and their manufacturing techniques, the filament winding of complex components, the mechanized manufacture of FRP components for aircraft secondary structures, a novel high strain-to-failure prepreg, the manufacture of accurate glass and carbon fiber preforms for resin injection, a helicopter composite tail unit, Al-Li alloys, the durability of Arall, the potential weight savings obtainable in future transport aircraft through the use of advanced materials, superplastically formed Ti and Al alloys for aerospace applications, and assembly bonding with room temperature-curing adhesives. Also discussed are novel composite systems for use in

primary aircraft structures, accelerated moisture absorption in carbon-epoxy, the thermoanalytic characterization of matrix resins and composites, the definition of microstructures in hybrid reinforced plastics, ceramic components for automotive powerplants, Kevlar-reinforced automotive components, metallized textile fabrics and their applications, and the role of S-2 glass fibers in advanced composites.

....

85X74649# CATEGORY 24 RPT#: AD-B090431L AD-E950666 NSWC/MP-84-258 CNT#: WR4502 F61544 84/04/00 190 PAGES UNCLASSIFIED DOCUMENT US GOV AGENCIES AND CONTRACTORS

UTTL: Proceedings of the Critical Issues in Materials Technology Workshop on Transverse Strength in Carbon-Fiber/Aluminum Composites held at White Oak, Silver Spring on 24-25 April 1984

AUTH: A/LEE, R. N. CORP: Naval Surface Weapons Center, Silver Spring, Md.

CIO: UNITED STATES; Workshop held at White Oak, Md., 24-25 Apr. 1984

MAJS: / *ALUMINUM/ *CARBON FIBERS/ *COMPOSITE MATERIALS/ *CONFERENCES/ *SURFACE FINISHING

MINS: / CORROSION/ GRAPHITE/ INTERFACES/ INTERFACIAL TENSION/ MATRIX MATERIALS/ MECHANICAL PROPERTIES/ VAPOR DEPOSITION

....

85X10084*# ISSUE 2 CATEGORY 24 84/12/00 22 PAGES UNCLASSIFIED DOCUMENT DOMESTIC

UTTL: Properties and potential of advanced carbon-carbon for space structures

AUTH: A/RUMMLER, D. R.; B/SAWYER, J. W.

CORP: National Aeronautics and Space Administration. Langley Research Center, Hampton, Va. SAP: Limited by ITAR In its Metal Matrix, Carbon, and Ceramic Matrix Composites p 149-170 (SEE X85-10074 02-24)

CIO: UNITED STATES

MAJS: / *AEROSPACE VEHICLES/ *CARBON-CARBON COMPOSITES/ *HIGH TEMPERATURE ENVIRONMENTS/ *TENSILE STRENGTH

MINS: / FLEXING/ SPACE SHUTTLES/ THERMAL CONDUCTIVITY/ THERMAL PROTECTION/ WEIGHT (MASS)

ABA: B.W.

ABS: Research results on the thermomechanical and thermophysical properties of advanced carbon-carbon (ACC) are discussed. Emphasis is placed on the effects of processing and prior thermal treatments on the room temperature and elevated temperature properties of this unique class of materials.

....

85X10074*# ISSUE 2 CATEGORY 24 RPT#: NASA-CP-2357 L-15918 NAS 1.55:2357 84/12/00 261 PAGES UNCLASSIFIED DOCUMENT DOMESTIC

UTTL: Metal Matrix, Carbon, and Ceramic Matrix Composites

AUTH: A/BUCKLEY, J. D. PAT: A/ed. CORP: National Aeronautics and Space Administration. Langley Research Center, Hampton, Va. SAP: Limited by ITAR

CIO: UNITED STATES; Sponsored in part by DOD Conf. held in Cocoa Beach, Fla., 19-20 Jan. 1984

MAJS: / *CARBON-CARBON COMPOSITES/ *CERAMIC MATRIX COMPOSITES/ *CONFERENCES/ *MECHANICAL PROPERTIES/ *METAL MATRIX COMPOSITES

MINS: / AEROSPACE INDUSTRY/ BORON FIBERS/ COATINGS/ FIBER REINFORCED COMPOSITES/ SILICON CARBIDES/ SURFACE FINISHING/ WHISKER COMPOSITES

ANN: Topics covered include design, manufacture, and fabrication of carbon-carbon composites for aerospace vehicles, boron fiber aluminum, silicon carbide whisker aluminum matrix, and fiber reinforced ceramic matrix composites. Fiber technology is presented on techniques for increasing the strength of boron fibers. The coating and

surface treatment of fibers is discussed as a method for improving the mechanical properties of both metal and ceramic matrix composites.

....

35A46526 ISSUE 22 PAGE 3249 CATEGORY 24 85/00/00 738 PAGES UNCLASSIFIED DOCUMENT

UTTL: Recent advances in composites in the United States and Japan; Proceedings of the Symposium, Hampton, VA, June 6-8, 1983

AUTH: A/VINSON, J. R.; B/TAYA, M. PAA: B/(Delaware, University, Newark) PAT: A/ED.; B/ED. SAP: Members, $60.; nonmembers, $75

CIO: UNITED STATES; Symposium sponsored by ASTM. Philadelphia, PA, ASTM (ASTM Special Technical Publication, No. 864), 1985, 738 p. For individual items see A85-46527 to A85-46563.

MAJS: / *COMPOSITE MATERIALS/ *FRACTURE MECHANICS/ *MECHANICAL PROPERTIES

MINS: / ACOUSTIC EXCITATION/ ADHESION/ BEND TESTS/ CARBON FIBER REINFORCED PLASTICS/ CERAMIC MATRIX COMPOSITES/ COMPRESSION TESTS/ FATIGUE TESTS/ FIBER ORIENTATION/ FIBER REINFORCED COMPOSITES/ FIBER STRENGTH/ GRAPHITE-EPOXY COMPOSITES/ JAPAN/ METAL MATRIX COMPOSITES/ PERFORATED PLATES/ PROBABILITY THEORY/ RESIDUAL STRESS/ SAINT VENANT PRINCIPLE/ SHEAR STRENGTH/ SILICON CARBIDES/ STRESS CONCENTRATION/ STRESS-STRAIN DIAGRAMS/ SURFACE FINISHING/ TECHNOLOGY ASSESSMENT/ ULTRASONIC SPECTROSCOPY/ UNITED STATES/ VISCOELASTICITY

ABA: O.C.

ABS: Among the topics discussed are load concentration factors in a chain-of-bundles probability model, the fracture behavior effects of graphite fiber/epoxy matrix adhesion, the fracture behavior of an SiC matrix reinforced with helical Ta fibers, damage initiation at curved free edges, the fracture toughness of a fiber-polymer cement concrete system, the fatigue behavior of alumina fiber-reinforced aluminum composites, metal matrix composite residual stresses due to temperature change, the stress and deformation of sandwich panels' curved faceplates under pressure loading, and the impact resistance of fiber composites. Also discussed are ferrite/resin composites for vibration damping, short fiber reinforced magnetic powder cores, carbon-carbon composites manufacture with fine coke, SiC-reinforced aluminum composite fabrication, meta matrix composites' work of fracture, the fiber-matrix reaction zone growth kinetics of SiC-reinforced Ti-6Al-4V, the corrosion resistance of metal matrix composites in marine environments, and the shear modulus of epoxy resin under compression.

....

85A45739 ISSUE 22 PAGE 3248 CATEGORY 24 85/07/00 5 PAGES In FRENCH UNCLASSIFIED DOCUMENT

UTTL: The state of the art of reinforced plastics

AUTH: A/LAETSCH, N. D. PAA: A/(Du Pont de Nemours International, S.A., Geneva, Switzerland)

CIO: SWITZERLAND; Materiaux et Techniques (ISSN 0032-6895), vol. 73, June-July 1985, p. 293-297. In French.

MAJS: / *AIRCRAFT CONSTRUCTION MATERIALS/ *FIBER REINFORCED COMPOSITES/ *REINFORCED PLASTICS/ *TECHNOLOGY ASSESSMENT

MINS: / CARBON FIBER REINFORCED PLASTICS/ COMPOSITE STRUCTURES/ HYBRID STRUCTURES/ KEVLAR (TRADEMARK)/ MECHANICAL PROPERTIES/ PRODUCTION ENGINEERING

ABA: M.S.K.

ABS: The material properties, manufacturing techniques, and tests of fiber-reinforced plastics intended for implementation as aircraft components are reviewed. The attractiveness of the composites is due to lower production costs and lighter weight. Composites are being designed with microstructures which resemble those of bone and wood, two strong natural materials. Thermosetting epoxy and phenolic resins receive the most attention as matrix materials, the former for strength, the latter for fire retardation. Although glass fibers have well known, satisfactory properties, they are heavy. Development efforts are therefore concentrating on Kevlar and carbon fibers as reinforcements. Carbon fibers are generally stronger and more expensive, while Kevlar has a higher pulling resistance and is thus preferable in some applications. Kevlar-carbon fiber hybrids provide enhanced properties. Since interlaminar defects are the predominant cause of failure, manufacturing and inspection techniques (particularly ultrasound and acoustic imaging) are being evaluated for

reducing the incidence of faulty products.

....

85A43126 ISSUE 20 PAGE 2931 CATEGORY 26 84/00/00 840 PAGES UNCLASSIFIED DOCUMENT

UTTL: PM aerospace materials; Proceedings of the International Conference, Bern, Switzerland, November 12-14, 1984. Volumes 1 & 2

CIO: UNITED KINGDOM; Conference sponsored by the Metal Powder Report. Shrewsbury, England, MPR Publishing Services, Ltd., 1984. Vol. 1, 523 p.; vol. 2, 317 p. For individual items see A85-43127 to

MAJS: / *AIRCRAFT CONSTRUCTION MATERIALS/ *CERAMICS/ *CONFERENCES/ *GAS TURBINE ENGINES/ *POWDER ALINS; METALURGY/ *SPACECRAFT CONSTRUCTION MATERIALS

MINS: / ALUMINUM ALLOYS/ HEAT RESISTANT ALLOYS/ HOT ISOSTATIC PRESSING/ HOT PRESSING/ MECHANICAL PROPERTIES/ METAL POWDER/ MICROSTRUCTURE/ NICKEL ALLOYS/ PARTICLE SIZE

ABS: Among the topics discussed are aerospace applications of powder materials, processes for ultraclean metal powder production, the properties of melt-spun, prealloyed Ni-base powders, the degassing of alloy powders by vacuum heating, superalloy powder consolidation at atmospheric pressure, explosive compacting, results of hot consolidation for rapidly solidified Ni-base alloys, dispersion-strengthened Ni for gas turbine applications, isothermal forging of powder metallurgy superalloys, and novel Al-alloys for aerospace applications. Also discussed are the manufacture of rapidly solidified light alloy powders, the microstructure of rapidly solidified Al alloy powders produced by ultrasonic gas atomization, dispersion-strengthened Al extrusions, SiC whisker-reinforced Al alloys, silicon nitride for hot isostatic pressing, and ceramic-reinforced ceramics.

....

85A41005# ISSUE 19 PAGE 2773 CATEGORY 24 84/00/00 9 PAGES In JAPANESE UNCLASSIFIED DOCUMENT

UTTL: Advanced composites - Present status and future trend

AUTH: A/KOBAYASHI, A.

CIO: JAPAN; Japan Society for Aeronautical and Space Sciences, Journal (ISSN 0021-4663), vol. 32, no. 367, 1984, p. 455-463. In Japanese.

MAJS: / *AIRCRAFT CONSTRUCTION MATERIALS/ *FIBER REINFORCED COMPOSITES/ *MECHANICAL PROPERTIES/ *METAL MATRIX COMPOSITES/ *POLYMER MATRIX COMPOSITES/ *TECHNOLOGY ASSESSMENT

MINS: / ALUMINUM/ CARBON FIBER REINFORCED PLASTICS/ GLASS FIBER REINFORCED PLASTICS/ PLASTIC AIRCRAFT STRUCTURES/ TITANIUM/ WHISKER COMPOSITES

ABA: S.H.

ABS: Current status and future potential of advanced composites are presented. Mechanical properties of fibers currently used for aerospace including E-glass, and carbon, boron, and aramid fibers, are discussed. Typical new composite materials included hybrid, oriented discontinuous fiber using SiC whisker, high temperature matrix of polyimide, and metal matrix with aluminum and fiber-reinforced titanium. Advantages of galvanic processes to prepare a metal matrix such as boron/Cu system are discussed. Developments of new aircraft using advanced composite materials, such as spanloader, multibody, and flatbed types, are described. Energy conservation of advanced composite materials is stressed.

....

85A39283 ISSUE 18 PAGE 2649 CATEGORY 26 RPT#: SAE SP-597 84/00/00 106 PAGES UNCLASSIFIED DOCUMENT

UTTL: Advanced aerospace materials technology; Proceedings of the Aerospace Congress and Expositinn, Long Beach, CA, October 15-18, 1984 SAP: Members, $20.; nonmember, $25

CIO: UNITED STATES; Congress and Exposition sponsored by the Society of Automotive Engineers. Warrendale, PA, Society of Automotive Engineers, Inc. (SAE SP-597), 1984, 106 p. For individual items see A85-39284 to A85-39291.

MAJS: / *AEROSPACE INDUSTRY/ *COMPOSITE MATERIALS/ *CONFERENCES/ *CONSTRUCTION MATERIALS/ *POWDER METALLURGY/

*RESEARCH AND DEVELOPMENT

MINS: / ALUMINUM ALLOYS/ CASTING/ GRAIN SIZE/ GRAPHITE-POLYMIDE COMPOSITES/ INJECTION MOLDING/ LOW DENSITY MATERIALS/ MARTEN SITIC STAINLESS STEELS/ MECHANICAL PROPERTIES/ POLYAMIDE RESINS/ RECIPITATION HARDENING/ SOLIDIFICATION/ THERMOPLASTIC RESINS/ WINGS/ YTTRIUM OXIDES

ABA: O.C.

ABS: Among the topics discussed are progress in the application of an oxide dispersion-strengthened alloy for small engine turbine blades, the development status of low density aluminum alloys, a novel method for the rapid solidification processing of high strength powder metallurgy aluminum alloys, and the development of fine grained\ cast axial an radial turbine heels of the nickel-base superalloy MAR-M247. Also covered are the injection molding of 1-4 PH stainless steel, the properties of poly (amine-imide)/graphite advanced composites, the production of damage-tolerant aerospace structures by means of k-polymer composite materials, and material evaluation methods for second generation composite transport wings.

....

85A37401 ISSUE 17 PAGE 2477 CATEGORY 24 84/00/00 9 PAGES UNCLASSIFIED DOCUMENT

UTTL: New developments in carbon fiber reinforcement AUTH: A/MCMAHON, P. E.; B/DALMIT, G. P. PAA: B/(Celanese Plastics and Specialties Co., Chatham, NJ)

CIO: UNITED STATES; IN: National Technical Conference, 16th, Albuquerque, NM, October 9-11, 1984, Proceedings (A85-37376 17-23). Covina, CA, Society for the Advancement of Material and Process Engineering, 1984, p. 600-608.

MAJS: / *CARBON FIBERS/ *FIBER STRENGTH/ *MECHANICAL PROPERTIES/ *TECHNOLOGY ASSESSMENT

MINS: / CARBON FIBER REINFORCED PLASTICS/ MODULUS OF ELASTICITY/ SPACECRAFT CONSTRUCTION MATERIALS/ STIFFNESS/ SURFACE FINISHING/ TENSILE PROPERTIES

ABA: O.C.

ABS: An account is given of the development and performance of the state-of-the-art GY-80 ultrahigh modulus carbon fiber, which offers higher stiffness and lower thermal expansion coefficient values than previous fibers of this type. Attention is given to the advantages to be derived from the coating of carbon fibers with sizes or finishes, en route to their conversion into fabrics, prepregs, braids, etc. Future space structure application advantages of the GY-80 fibers are noted.

....

85A37376 ISSUE 17 PAGE 2476 CATEGORY 23 84/00/00 792 PAGES UNCLASSIFIED DOCUMENT

UTTL: National Technical Conference, 16th, Albuquerque, NM, October 9-11, 1984, Proceedings

SAP: $60

CIO: UNITED STATES; Conference sponsored by the Society for the Advancement of Material and Process Engineering. Covina, CA, Society for the Advancement of Material and Process Engineering (National SAMPE Technical Conference Series. Volume 16), 1984, 792 p. For individual items see A85-37377 to A85-37414.

MAJS: / *COMPOSITE MATERIALS/ *CONFERENCES/ *MATERIALS SCIENCE/ *PRODUCTION ENGINEERING

MINS: / ADHESIVES/ AEROSPACE ENGINEERING/ BONDING/ CARBON-CARBON COMPOSITES/ CERAMICS/ COMPUTER AIDED MANUFACTURING/ ELECTRONICS/ ENVIRONMENTAL TESTS/ FIBER REINFORCED COMPOSITES/ MAINTENANCE/ MATERIALS TESTS/ MATRIX MATERIALS/ METAL MATRIX COMPOSITES/ POLYMERS/ RADIATION EFFECTS/ REINFORCING FIBERS/ REINFORCING MATERIALS/ ROBOTICS/ SPACECRAFT CONSTRUCTION MATERIALS

ABA: O.C.

ABS: The present conference gives attention to the development status of materials technologies in such diverse fields as electronic hardware, advanced composite processing, materials repair methods, educational resources for materials science and engineering, robotic and automated industrial processes, radiation effects on materials, metal matrix composites, glass/ceramic systems, carbon/carbon refractory composites, and adhesive

systems and joining methods. Also discussed are composite matrix chemical and mechanical properties, polymeric material developments, the testing of composite materials, and the inspection of composite structures. Emphasis is given to the prediction of composite systems' performance, novel manufacturing methods, and advanced design and analysis techniques for composite structures in aerospace applications.

....

85A35389*# ISSUE 16 PAGE 2312 CATEGORY 16 85/06/00 7 PAGES UNCLASSIFIED DOCUMENT

UTTL: Structural concepts for future space transportation system orbiters

AUTH: A/TAYLOR, A. H.; B/JACKSON, L. R.; C/DAVIS, R. C.; D/CERRO, J. A.; E/SCOTTI, S. J. PAA: C/(NASA, Langley Research Center, Hampton, VA); E/(Kentron International, Inc., Hampton, VA)

CORP: National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.; Kentron International, Inc., Hampton, Va.

CIO: UNITED STATES; (American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, AIAA Paper 83-0210) Journal of Spacecraft and Rockets (ISSN 0022-4650), vol. 22, May-June 1985, p. 333-339. Previously cited in issue 05, p. 606, Accession no. A83-16585.

MAJS: / *SPACE SHUTTLE ORBITERS/ *SPACECRAFT DESIGN/ *SPACECRAFT STRUCTURES/ *STRUCTURAL DESIGN CRITERIA/ *TECHNOLOGICAL FORECASTING

MINS: / AIRFRAMES/ CARBON-CARBON COMPOSITES/ CRYOGENIC FLUID STORAGE/ PROPELLANT TANKS/ SPACECRAFT CONSTRUCTION MATERIALS/ STRUCTURAL WEIGHT /THERMAL PROTECTION

....

85A27119 ISSUE 11 PAGE 1516 CATEGORY 26 84/00/00 22 PAGES UNCLASSIFIED DOCUMENT

UTTL: Aluminum-lithium alloys for aircraft structure - An overview

AUTH: A/QUIST, W. E.; B/NARAYANAN, G. H.; C/WINGERT, A. L. PAA: C/(Boeing Commercial Airplane Co., Seattle, WA)

CIO: UNITED STATES; IN: Aluminum-lithium alloys II; Proceedings of the Second International Aluminum-Lithium Conference, Monterey, CA, April 12-14, 1983 (A85-27101 11-26). Warrendale, PA, Metallurgical Society of AIME, 1984, p. 313-334.

MAJS: / *AIRCRAFT CONSTRUCTION MATERIALS/ *ALUMINUM ALLOYS/ *LITHIUM ALLOYS/ * TECHNOLOGY ASSESSMENT

MINS: / AEROSPACE INDUSTRY/ AIRFRAME MATERIALS/ METALLURGY/ PRODUCT DEVELOPMENT/ STRUCTURAL WEIGHT

ABA: Author

ABS: The use of lithium bearing aluminum alloys for aircraft structure began in 1957 with the use of alloy X2020 on the Navy RA-5C Vigilante. Since that initial application, production problems and concerns about brittle behavior thwarted further use of these alloys in the aircraft of western nations. However, the increasing need for more efficient airframes and improved materials of construction has rekindled interest in Al-Li type alloys, primarily because of the substantially lower density that these alloys offer. Serious research and development efforts have been underway since the early 1970's in the U.S. and Great Britain, and these studies have identified the primary technical reasons for the brittle behavior of aluminum-lithium type alloys and have also suggested solutions to this problem. Current prospects are bright for the near term development of several high strength lithium bearing aluminum alloys that will be suitable for aerospace applications and that should find a broad application in this industry.

....

84X73372# CATEGORY 34 RPT#: AD-C033061 AD-E301248 DNA-TR-82-30-VOL-1 CNT#: DNA001-82-C-0069 DA PROJ. 094-QAXD 82/09/30 2 VOLS 766 PAGES SECRET DOCUMENT US GOV AGENCIES AND CONTRACTORS

UTTL: Proceedings of the Shock Physics Aerospace Systems Conference, volume 1 (U)

AUTH: A/SLAUGHTER, J. I.

CORP: Kaman Tempo, Alexandria, Va.

CIO: UNITED STATES

MAJS: / *COMPOSITE MATERIALS/ *CONFERENCES/ *GUSTS/ *LASER PROPULSION/ *LASER WEAPONS / *MISSILE SYSTEMS/ *NUCLEAR EXPLOSION EFFECT/ *NUCLEAR WEAPONS/ *RADIATION DAMAGE/ *RADIATION HARDENING/ *REENTRY VEHICLES/ *SHOCK WAVES

MINS: / AEROSPACE SYSTEMS/ AIR BREATHING ENGINES/ ANGLE OF ATTACK/ BLAST LOADS/ FLIGHT CONTROL/ JET ENGINES/ PARTICLE

....

84A34010# ISSUE 15 PAGE 2122 CATEGORY 18 RPT#: AIAA PAPER 84-1121 84/00/00 9 PAGES UNCLASSIFIED DOCUMENT

UTTL: Materials and structures for space applications

AUTH: A/GARIBOTTI, J. F.; B/DAVIS, W. E.; C/ADSIT, N. R.

PAA: C/(HR Textron, Inc., Irvine, CA)

CIO: UNITED STATES; IN: Space Systems Technology Conference, Costa Mesa, CA, June 5-7, 1984, Technical Papers (A84-34004 15-12). New York, American Institute of Aeronautics and Astronautics, 1984, p. 50-58.

MAJS: / *SPACECRAFT CONSTRUCTION MATERIALS/ *SPACECRAFT STRUCTURES/ *TECHNOLOGICAL FORECASTING

MINS: / GRAPHITE-EPOXY COMPOSITES/ HUBBLE SPACE TELESCOPE/ METAL MATRIX COMPOSITES/ REMOTE MANIPULATOR SYSTEM/ SPACE TRANSPORTATION SYSTEM/ TECHNOLOGY ASSESSMENT/ THERMAL PROTECTION

ABA: G.R.

ABS: The present investigation is concerned with the state of the art in materials and structures for space applications, taking into account also future trends regarding these technologies. It is pointed out that the development of the Space Shuttle Orbiter required significant advances in the technologies of structures and materials. Some of these advances are related to the reusable thermal protection system, the light weight, high strength main frame truss structure, and the extensive use of lightweight composites for major components. Attention is given to the tile/pad/substrate profile, the remote manipulator system, the arm boom design, the space telescope major subsystems, and constructional changes from graphite epoxy to graphite aluminum. Structures, mechanisms, and materials technology needs for space stations are discussed, and a future space transportation system is described.

....

84A32676 ISSUE 14 PAGE 2016 CATEGORY 26 82/00/00 424 PAGES UNCLASSIFIED DOCUMENT

UTTL: Superplastic forming of structural alloys; Proceedings of the Symposium, San Diego, CA, June 21-24, 1982

AUTH: A/PATON, N. E.; B/HAMILTON, C. H. PAA: A/(Rockwell International Corp., Pittsburgh, PA); B/(Rockwell International Science Center, Thousand Oaks, CA) PAT: A/ED.; B/ED.

SAP: Members, $24.; nonmembers, $36

CIO: UNITED STATES; Symposium sponsored by the Metallurgical Society AIME and American Society for Metals. Warrendale, PA, Metallurgical Society of AIME, 1982, 424 p.

MAJS: / *CONFERENCES/ *FORMING TECHNIQUES/ *HEAT RESISTANT ALLOYS/ *HIGH STRENGTH ALLOYS/ *METAL WORKING/ *SUPERPLASTICITY

MINS: / AEROSPACE INDUSTRY/ AIRCRAFT STRUCTURES/ ALUMINUM ALLOYS/ DESTRUCTIVE TESTS/ GRAIN BOUNDARIES/ MECHANICAL PROPERTIES/ METAL SHEETS/ NICKEL ALLOYS/ PLASTIC FLOW/ PRODUCT DEVELOPMENT/ STRAIN RATE/ TITANIUM ALLOYS

ABA: J.N.

ABS: Research on superplasticity as a low-cost production method for the manufacture of complex components is presented in terms of basic mechanics, superplastic materials, superplastic forming processes and applications and cavitation in superplastic alloys. Specific areas of study include the superplastic behavior of metals; superplasticity in titanium-base alloys, high-strength aluminum alloys, and nickel-base alloys; and

superplastic foring of sheet metal. Attention is also given to aerospace applications of SPF and SPFDB and commercial applications of superplastic sheet forming. For individual items see A84-3677 to A84-32687
....

84A28232 ISSUE 11 PAGE 1521 CATEGORY 24 83/00/00 12 PAGES UNCLASSIFIED DOCUMENT

UTTL: SEM fractographic analysis of metal-matrix composites exposed to elevated temperature, short duration environments

AUTH: A/HUNN, D. L. PAA: A/(Texas, University, Arlington, TX)

CIO: UNITED STATES

IN: Mechanical behavior of metal-matrix composites; Proceedings of the Symposium, Dallas, TX, February 16-18, 1982 (A84-28226 11-24). Warrendale, PA, The Metallurgical Society of AIME, 1983, p. 83-94.

MAJS: / *ELECTRON MICROSCOPY/ *FRACTOGRAPHY/ *HIGH TEMPERATURE TESTS/ *METAL MATRIX COMPOSITES/ *MISSILE DESIGN

MINS: /ALUMINUM ALLOYS/ ALUMINUM BORON COMPOSITES/ FAILURE MODES/ SILICON CARBIDES/ TENSILE TESTS

ABA: Author

ABS: Elevated temperature, short time exposure tensile behavior of metal matrix composites is of high interest in advanced missile designs. Tensile tests have been performed on titanium clad boron/aluminum (B4CB/Al) and silicon carbide particulate reinforced aluminum (SiC-p/Al) at various temperatures in air after a 2 minute soak to characterize their behavior. The temperatures that were examined include 700 F, 900 F and 1100 F for the B4CB/Al composite and 500 F, 700 F and 900 F for the SiC-p/Al composite. This paper reflects the SEM work that was performed on each of the failure surfaces of the various tensile specimens. Failure modes were readily identified for the continuous fiber reinforced composite (B4CB/Al) but were not as obvious for the discontinuously reinforced composite SIC-p/Al.
....

83X72974# Category 12 RPT#: AD-B070157L SD-TR-82-102 82/10/00 96 PAGES UNCLASSIFIED DOCUMENT US GOV AGENCIES

UTTL: Space Systems and Technology Workshop 2. Manufacturing panel proceedings

TLSP: Final Report

CORP: Air Force Space Div., Los Angeles, Calif.

CIO: UNITED STATES; Workshop held in Albuquerque, N. Mex., 20-24 Sep. 1982

MAJS: / *AEROSPACE ENVIRONMENTS/ *LARGE SPACE STRUCTURES/ *MATRIX MATERIALS/ * PHOTOVOLTAIC EFFECT/ *QUALITY CONTROL / *SPACE MANUFACTURING

MINS: / AEROSPACE ENGINEERING/ COMPOSITE MATERIALS/ ELECTRIC GENERATORS/ INDUSTRIAL PLANTS/ METALS/ OPTICAL

EQUIPMENT/ SPACE COMMERCIALIZATION
....

83X72199# CATEGORY 26 RPT#: AD-505298 MHR-69-16 CNT#: F33657-69-C-0014 69/06/00 72 PAGES CONFIDENTIAL DOCUMENT US GOV AGENCIES AND CONTRACTORS

UTTL: Soviet activities in the field of aluminum technology (U)

CORP: McGraw-Hill Information Systems Co., Wright-Patterson AFB, Ohio.

CIO: UNITED STATES

MAJS: / *ALUMINUM/ *ALUMINUM ALLOYS/ *CASTING/ *COMPOSITE MATERIALS/ *EXTRUDING/ * FORGING/ *POWDER METALLURGY/ *PROCESS CONTROL (INDUSTRY)

MINS: /RESEARCH MANAGEMENT /TECHNOLOGY ASSESSMENT / U.S.S.R.

••

83A37861# ISSUE 17 PAGE 2516 CATEGORY 37 83/00/00 6 PAGES UNCLASSIFIED DOCUMENT

UTTL: New metal technologies in airframe construction

AUTH: A/SAHM, K.-F.

CIO: UNKNOWN Dornier-Post (English Edition) (ISSN 0012-5563), no. 2, 1983, p. 46-51.

MAJS: / *AIRCRAFT CONSTRUCTION MATERIALS/ *AIRFRAMES/ *ALUMINUM ALLOYS/ *POWDER METALLURGY/ *TITANIUM ALLOYS/ *WEIGHT REDUCTION

MINS: / COSTS/ HOT ISOSTATIC PRESSING/ MECHANICAL PROPERTIES/ METAL SHEETS/ MICROSTRUCTURE/ STRUCTURAL WEIGHT/ TECHNOLOGY ASSESSMENT

ABA: A.L.W.

ABS: Three advanced metallics technologies with the potential for reducing the structural weight of future aircraft are presented. Powder metallurgy is shown to enable the production of finer microstructures and improved mechanical properties in conventional and novel aluminum alloys. The technique of superplastic sheet metal foring combined with diffusion bonding is under development as a means for the low-cost production of integral titanium sheet metal constructions and is also being investigated for use wit sufficiently superplastic aluminum alloys. Finally, the advanced aluminum casting techniques of sand-casting and precision casting show promise for the reduction of aircraft production and operating costs. The potential of other metals technologies such as lithium aluminum alloys, the combination of binding and spot welding, hot isostatic pressing and composites is also noted.

••

83A33961 ISSUE 15 PAGE 2136 CATEGORY 26 82/00/00 7 PAGES In GERMAN UNCLASSIFIED DOCUMENT

UTTL: Aspects of metallography and manufacturing technology regarding the superplastic forming of TiAl6V4

AUTH: A/BECK, W.; B/WINKLER, P. J. PAA: A/(Vereinigte Flugtechnische Werke GmbH, Bremen, West Germany); B/(Messerschmitt-Boelkow-Blohm GmbH, Munich, West Germany)

CIO: GERMANY,FEDERAL REPUBLIC OF

IN: Highly stressed materials, with aviation considered as an example (A83-33951 15-26). Oberursel, West Germany, Deutsche Gesellschafat fuer Metallkunde, 1982, p. 129-135. In German.

MAJS: / *AEROSPACE INDUSTRY/ *FORMING TECHNIQUES/ *METALLOGRAPHY/ *SUPERPLASTICITY/ *TECHNOLOGY ASSESSMENT/ *TITANIUM ALLOYS

MINS: / ALUMINUM ALLOYS/ COST EFFECTIVENESS/ MATERIALS SCIENCE/ METAL SHEETS/ WEIGHT REDUCTION

ABA: G.R.

ABS: The titanium alloy TiAl6V4 has high strength, high-temperature stability, and satisfactory corrosion resistance. In this connection it has become an important structural material for the aerospace industry. However, cost factors related to an employment of this alloy are high. Components made of titanium have, in most cases, a complex form, and material losses of more than 90 percent in connection with machining operations are not uncommon. This situation provides the motivation for efforts to develop new more cost-effective manufacturing procedures. Superplastic forming in conjunction with diffusion welding, or without it, makes it possible to process titanium sheet by means of novel approaches which could not be employed on the basis of conventional procedures. It will now be feasible to utilize unorthodox component configurations which may lead to savings in cost and weight. Attention is given to work which is being conducted in West Germany with the objective to utilize the considered technology for some specific aerospace applications.

••

82X73554# CATEGORY 15 RPT#: AD-B062009L ATC-R-92000/OCT-76-VOL-1 AFWAL-TR-81-4131-VOL-1 CNT#: N00019-80-C-3027 ARPA ORDER 4010 AF PROJ. 2666 81/11/00 3 VOLS 14 PAGES UNCLASSIFIED DOCUMENT US GOV AGENCIES

UTTL: Carbon-carbo technology for future strategic and tactica missiles. Volume 1: Executive summary TLSP: Final Report, Jun. - Nov. 180

AUTH: /FORCHT, B. A.; B/HARDER, I. E.; C/PETERSEN, D. H.; D/PORTER, J. L.CORP Vought Corp., Dallas, Tex.

CIO: UNITED STATES; Wright-Patterson AFB, Ohio AFWAL

MAJS: / *CARBON-ARBON COMPOSITES/ *GAS TURBINE ENGINES/ *MISSILE DEIGN

MINS: /ENGINE PARTS /MILITARY TECHNOLOGY /TECHNOLOGY ASSESSMENT /WEAPON SYSTEMS

....

82X71731 CATEGORY 26 RPT#: AD-37849 MHR-66-29 66/06/00 58 PGES CONFIDENTIAL DOCUMENT US GOV AGENCIES

UTTL: Soviet activities in the field of aluminum technology fabricating and casting practices (U)

CORP: Dodge (F. W.) Co., New York.

CIO: UNITED STATES

MAJS: / *ALUMINUM ALLOYS/ *CASTING/ *FABRICATION/ *PRODUCTION ENGINEERING

MINS: /MACHINING /METAL WORKING TECHNOLOGY ASSESSMENT / U.S.S.R.

....

82A47042# ISSUE 24 PAGE 3780 CATEGORY 39 RPT#: IAF PAPER 82-385 82/09/00 12 PAGES UNCLASSIFIED DOCUMENT

UTTL: Recent progress in composite materials application for space systems

AUTH: A/KLUG, J. L.; B/KALK, K. W. PAA: B/(M.A.N. - Neue Technologie, Munich, West Germany)

CIO: GERMANY, FEDERAL REPUBLIC OF; International Astronautical Federation, International Astronautical Congress, 33rd, Paris, France, Sept. 27-Oct. 2, 1982, 12 p.

MAJS: / *AEROSPACE ENGINEERING/ *FIBER REINFORCED COMPOSITES/ *ROCKET VEHICLES/ * SPACECRAFT CONSTRUCTION MATERIALS/ *TECHNOLOGY ASSESSMENT

MINS: / ARIANE LAUNCH VEHICLE/ CARBON FIBER REINFORCED PLASTICS/ CYLINDRICAL SHELLS/ PAYLOAD MASS RATIO/ SANDWICH STRUCTURES/ STRUCTURAL DESIGN/ STRUTS

ABA: N.B.

ABS: The use of fiber-reinforced plastics (FCM) as structural components of launcher rockets is evaluated. The influence of a rocket's structural mass on the attainable payload in transfer orbit is determined from the performance calculations for several different rockets, the rocket structures which could advantageously be replaced by structures of FCM are considered, and the mass of the composite material structures are estimated. An intermediate stage structure from the second stage of the Ariane 1 rocket is presented as an applied example of the use of FCM components. The strength lay-out and the precision-winding production process are examined and compared to the conventional metal construction. The structural concept for the FCM components is based on a shell of sandwich construction, which consists of two skins with interposed stringers or annular ribs. This concept is shown to be flexible and the structural design can be adapted to local problems of force induction or cut-outs. In addition, tension/compression struts made from CFRP are developed and evaluated for aerospace and aviation applications. For load transmission between CFRP tubes and aluminum fittings a positive connection for both tension and compression is used. It is found that the use of CFRP struts can save about 50% of the weight of conventionally fabrication aluminum struts.

....

82A38699 ISSUE 19 PAGE 3038 CATEGORY 37 82/07/00 9 PAGES UNCLASSIFIED DOCUMENT

UTTL: Laser welding - State of the art review.

AUTH: A/MAZUMDER, J. PAA: A/(Illinois, University, Urbana, IL)

CIO: UNITED STATES; (Lasers in Metallurgy, Metallurgical Society of AIME, 1982.) Journal of Metals, vol. 34, July 1982, p. 16-24.

MAJS: / *CARBON DIOXIDE LASERS/ *CONTINUOUS WAVE LASERS/ *HIGH POWER LASERS/ *LASER WELDING

MINS: / ABSORPTIVITY/ ALUMINUM ALLOYS/ IRIDIUM/ MECHANICAL PROPERTIES/ STEELS/ TECHNOLOGY ASSESSMENT/ TITANIUM ALLOYS

ABA: R.K.R.

ABS: The advantages of laser welding, rivaled only by electron beam welding (EBW), are enumerated, and its principles and variables are explained. Studies of laser welds in aluminum and its alloys, steel, titanium and its alloys, and iridium alloys are presented. The welding of aluminum alloys have proved to be difficult because of high surface reflectivity, and high amounts of porosity often appear. A systematic study of the laser welding of 1/4-inch thick Al-Mg alloy (5083), using a 10 kW CO2 laser and a gas shielding system, produced porosity-free welds. The EBW technique has been the most popular method for welding the Ti-6Al-4V titanium alloy, but it has been found that CO2 laser beams may be a more efficient method of welding this alloy. X-ray radiographs have shown no cracks, porosity or inclusions in successfully welded Ti-6Al-4V. Also, it is reported that, under proper conditions, the fatigue characteristics of this weld can be the same as in the base metal. Composites showing structural variations and the transmission electron micrographs of the Ti-6Al-4V weld are included.

....

82A24804 ISSUE 10 PAGE 1597 CATEGORY 39 81/00/00 18 PAGES In GERMAN UNCLASSIFIED DOCUMENT

UTTL: The fracture characteristics of a number of notched carbon-epoxide laminates

AUTH: A/OCHIAI, S.; B/PETERS, P. W. M. PAA: A/(Kyoto University, Kyoto, Japan); B/(Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Institut fuer Werkstoff-Forschung, Cologne, West Germany)

CIO: JAPAN

In: Composite materials; Lecture and Discussion Meeting, Constance, West Germany, April 17, 18, 1980, Reports. (A82-24801 10-24) Oberursel, West Germany, Deutsche Gesellschaft fuer Metallkunde, 1981, p. 197-214. In German.

MAJS: / *CARBON FIBER REINFORCED PLASTICS/ *EPOXY MATRIX COMPOSITES/ *FRACTURE MECHANICS/ *LAMINATES

MINS: / CRACK PROPAGATION/ FAILURE MODES/ NOTCH TESTS/ STRESS ANALYSIS

ABA: G.R.

ABS: One of the reasons for certain delays with respect to a more wide-spread employment of light fiber-reinforced plastics is related to the complex mechanical characteristics of these materials, in particular also with respect to fracture mechanics. The considered investigation has the objective to find out whether fracture-mechanics approaches employed in connection with conventional materials can also be used for fiber-reinforced materials. The materials studied consist of an epoxide matrix in which carbon filaments are embedded. Composites in which the fibers are aligned in different directions are studied, taking into account effects related to the orientation of the individual layers and the layer thickness. It is found that procedures based on the concept of crack resistance are not suited for a prediction regarding fracture. Point and mean stress criteria fail also to provide this information.

....

82A23752 ISSUE 9 PAGE 1390 CATEGORY 37 81/00/00 40 PAGES UNCLASSIFIED DOCUMENT

UTTL: Diffusion welding

AUTH: A/SCHWARTZ, M. PAA: A/(United Technologies Corp., Sikorsky Aircraft Div., Stratford, CT)

CIO: UNITED STATES

In: Welding technology for the aerospace industry; Proceedings of the Conference, Las Vegas, NV, October 7, 8, 1980. (A82-23751 09-37) Miami, FL, American Welding Society, 1981, p. 1-40.

MAJS: / *DIFFUSION WELDING/ *FABRICATION/ *SOLID STATE/ *TECHNOLOGY ASSESSMENT

MINS: / ALUMINUM ALLOYS/ BIBLIOGRAPHIES/ BRAZING/ GRAIN BOUNDARIES/ NICKEL ALLOYS/ TITANIUM ALLOYS

ABA: V.L.

ABS: Solid-state joining processes constituting a general category of diffusion welding are reviewed with reference to the metallurgical aspects and key variables of the processes, equipment and tooling, materials, and applications. Specific processes examined include friction welding, explosive welding, high-pressure and roll welding (yield-stress controlled), forge welding, gas pressure welding (isostatic), vacuum diffusion welding (creep controlled), press or die pressure welding, and transient liquid phase bonding. Other processes discussed include continuous seam diffusion bonding, creep isostatic pressing, superplastic forming/diffusion bonding, and diffusion brazing techniques.

....

80N30494# ISSUE 21 PAGE 2823 CATEGORY 26 RPT#: AD-A086427 CNT#: DA-ERO-77-G-011 DA PROJ. 1T1-61102-BH-57 80/04/00

39 PAGES UNCLASSIFIED DOCUMENT

UTTL: The role of hydrogen in the stress corrosion failure of high strength Al-Zn-Mg alloys and sensitized austenitic stainless steels TLSP: Final Annual Technical Report

AUTH: A/CHRISTODOULOU, L.; B/LACKEY, M. G.; C/FLOWER, H. M.; D/HUMPHREYS, F. J.; E/SWANN, P. R.

CORP: Imperial Coll. of Science and Technology, London (England). AVAIL.NTIS

SAP: HC A03/MF A01

CIO: UNITED KINGDOM

MAJS: / *AUSTENITIC STAINLESS STEELS/ *FAILURE MODES/ *HIGH STRENGTH ALLOYS/ *STRESS CORROSION

MINS: / ALUMINUM ALLOYS/ CONCENTRATION (COMPOSITION)/ FRACTURE MECHANICS/ GRAIN BOUNDARIES

ABA: GRA

ABS: An investigation into the effect of exposure of Al-Zn-Mg alloys to water vapor has shown that hydrogen, produced by the reaction is absorbed by both the alloy grain boundaries and matrix. The amount of absorbed hydrogen depends on the local chemistry and the metal/oxide interface and is influenced by alloying additions. Attainment of a critical concentration of dissolved hydrogen in the boundaries leads to brittle intergranular fracture on the subsequent application of stress. Attainment of a critical hydrogen concentration in the matrix leads to transgranular cleavage fracture. Depending upon the alloy composition and heat treatment bubbles of gaseous hydrogen can be formed at suitable sites within the alloys such as grain boundary particles. The formation of grain boundary bubbles reduces embrittlement by reducing the local concentration of dissolved hydrogen. It is proposed that the interaction of stress and environmental variables with the above criteria governs the environmental failure of Al-Zn-Mg alloys in aqueous and water vapor containing environments. It is suggested that such failures are hydrogen embrittlement dominated.

....

No.: S2 **Title:** Structural Integrity Verification

Operational Requirement:

Provide on-board structural verification for recoverable vehicles.

Rationale:

To avoid extensive recoverable vehicle downtimes which severely impact manifest capability. This downtime causes drastic increase in life cycle costs because of reduced flight rate.

Sample Concept:

Recoverable structures designed and manufactured with adequate built-in strain gauges, corrosion sensors, and BIT to provide adequate warning of structure deterioration.

Technology Requirement:

Determination of sensor requirements for structural integrity.

Development of required sensors to detect corrosion, etc.

Technology References:

NASA/RECON: 87K10697, 85A47011

87K10697 (MOD-000) CNT#: NAS3-25141 DUN#: 0813014 CIC#: 2470003 505-62-81 National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio. Pratt and Whitney Aircraft, East Hartford, Conn.

UTTL: Sensors for ceramic components in advanced propulsion systems UNCLASSIFIED MARCH 10, 1987 / MARCH 9, 1990 REPORTS EXPECTED Tech monitor not available

MAJS: / *CALIBRATING/ *CARBON-CARBON COMPOSITES/ *CERAMICS/ *COMPATIBILITY/ * COMPOSITE MATERIALS/ *FAILURE ANALYSIS/ *HEAT TRANSFER/ *MEASURING INSTRUMENTS/ *PROPULSION/ *SILICON/ *STRAIN GAGES/ *SURFACE TEMPERATURE/ * SYSTEMS COMPATIBILITY/ *SYSTEMS ENGINEERING/ *TEMPERATURE MEASURING INSTRUMENTS/ *THERMAL CONTROL COATINGS/ *THERMAL CYCLING TESTS

....

85A47011 ISSUE 22 PAGE 3292 CATEGORY 38 CNT#: W-7405-ENG-82 84/00/00 7 PAGES UNCLASSIFIED DOCUMENT

UTTL: Inference of compressive stresses at joined interfaces using ultrasonic reflectivity

AUTH: A/THOMPSON, D. O.; B/REHBEIN, D. K.; C/SKILLINGS, B. J.; D/SMITH, J. F. PAA: D/(DOE, Ames Laboratory, Ames, IA)

CIO: UNITED STATES; IN: Nondestructive methods for material property determination; Proceedings of the Symposium, Hershey, PA, April 6-8, 1983 (A85-47001 22-38). New York, Plenum Press, 1984, p. 171-177.

MAJS: / *COMPRESSION LOADS/ *FASTENERS/ *JOINTS (JUNCTIONS)/ *NITINOL ALLOYS/ *STRESS ANALYSIS/ *ULTRASONIC TESTS

MINS: / NICKEL ALLOYS/ REFLECTANCE/ SHAPE MEMORY ALLOYS/ SOLID-SOLID INTERFACES

ABA: G.R.

ABS: A problem of considerable interest is related to the nondestructive determination of the compressive component of stress in various kinds of interference fasteners. The usual techniques employed for stress measurements are not suited for the considered case. The present paper is concerned with results which were obtained in a study of Nitinol couplers by means of a procedure utilizing ultrasonic reflectivity and suitable interpretive concepts. Nitinol, a nickel-titanium alloy, is a shape memory material which undergoes a rather special type of martensitic transformation. The Nitinol fastener is a short, thick-walled hollow cylinder. Attention is given to aspects of sample preparation and stress characterization, ultrasonic measurements, and experimental results and interpretation.

....

No: S3 **Title:** Integral TPS

Operations Requirement:

Eliminate time consuming critical inspection, repair, and test of orbiter-type TPS.

Rationale:

Orbiter tile has structural characteristics akin to high-density styrofoam, i.e., it's brittle and delicate. Strength of the bond to vehicle substrate is critical and very difficult to ascertain. Repair/test/validation of TPS is very time consuming, requires expensive GSE and high-tech test equipment, and multiple eyes to observe/verify procedures.

During Nov./Dec. 1985, 514 people were assigned to the OPF. SPC WBS 1.1.1.7 "Orbiter Tile Operations" was staffed at 123.2 people. 82 of those were assigned specifically to 51-L TPS support and performed the following work:

WAD	TITLE	SERIAL HRS.
V6028	Orbiter post flight TPS inspection	--
V9024	Orbiter TPS maintenance/operations	60
N/A	Orbiter TPS waterproofing	168
V9022	ET door cycles/TPS operations	120
V6035	RSI pre-rollout inspection and upper surface waterproofing	71
	Total:	419

The 51-L as-run schedule shows the first three above operations starting as soon as the Orbiter rolled into the OPF but does not identify how long they continue. The STS-XX schedule allows 60 hrs. for both the inspection and the maintenance operations and 168 hrs. for the waterproofing.

419 hours is 17.5 days, or 2.5 weeks. Each of 82 persons can be expected to have worked a maximum of 60 hours/week for a total of 82 x 60 x 2.5 = 12,300 M/Hs TPS support for one flight!

TYPICAL TPS WAD WORK/FLOW

o Tiles replaced	250
o FIBs replaced	30
o Gap fillers replaced	550
o PRs worked	850
o DRs worked	200
o PCR data sheets	2,900
o OMIs	7

To corroborate the above data (and further condemn shuttle-style TPS) the following data are provided for STS-31, orbiter Atlantis, launched November 26, 1985 (flight 23). Data source is the Shuttle II Data Base Development prepared by SPC subcontractor Pan Am World Services, Inc., dated July 24, 1987.

SCHEDULED MAINTENANCE, SYSTEM 09, TPS

TASK	MANHOURS
Technician	10,636
Engineering	9,466
Safety	851
Quality	4,042
PP&C	2,340
Support	19,677
Logistics	5,637
Overhead	4,467
Total	57,115

NOTES

1. This data for STS-31 only
2. Headcount 264
3. OPF Dwell Time 27 days
4. Orbiter Challenger was in parallel processing during this period.

The following supplementary data are also extracted from the reference Pan Am Shuttle II Data Base for STS-31.

STS-31 TPS TECH MANHOURS ONLY

		TIME	TECHS	MHRS
	OPF			
TPS	Post Flight Inspection and Repair	164	64	10,496
OMI	V7253A, Orbiter Window Polishing	70	2	140
	VAB			
OMI	T5245A ET Nose Cone Fairing c/o	19	6.4	121
OMI	T5245B Nose Cone Fairing Trim	4	6.3	25
	Total	257		10,782

MANHOUR COMPARISON FOR THREE MISSIONS

The Shuttle II Data Base also provides the following TPS manhour tabulation by WBS for missions STS 31, 32, and 33.

DESCRIPTION	MISSION AND MHRS STS31	STS32	STS33
WBS K1117 TPS			
. Repair/Replacement	9,331	24,360	10,345
. Waterproofing	1,184	147	1,158
. Modifications	0	2,405	0
Totals	10,515	26,912	11,503

Sample Concepts:

Provide simplified, skin-integral, large panel, "old technology" TPS, i.e., temperature resistant pyrolytic graphite, metals and composites as proposed for earlier STS concepts.

Reexamine and redefine reentry mode to multi-skip, once-around reentry a la Sanger, and reexamine cross-range requirements impact on TPS configuration.

Requirement:

Development only. Previous studies/designs utilized much less sensitive TPS.

Technology References:

NASA/RECON (abstracts attached):

86X10037, 86A18037, 86A15201, 85X10346, 85N12085, 85A38450, 85A28801, 85A17092, 84X74531, 84X10382, 84X10381, 84X10379, 84X10376, 84X10375, 84X10374, 84X10372, 84X10371, 84X10366, 84X10356, 84N32505, 84N24709, 84A47046, 84A42651, 84A41928, 84A37496, 84A37494, 84A37493, 82N23262, 82A31896

Conclusion:

A robust, low maintenance TPS can reduce the KSC shuttle equivalent headcount by at least 123 persons. Unquantified benefits would be very far reaching in cost and schedule enhancement. The Phase 3 Addendum to Phase 2 Final Report, "51-L Work Volume Indicators", dated September 30, 1988 (page 3) shows the SPC skill mix includes 32.1% "untabulated administrative" (QA, safety, secretarial, analysts, clerks, security, business, human resources, etc.) Applying that ratio to the 123 heads above provides a conservative additional reduction of 123 x .32 = 39; for a total potential headcount reduction of 162 people.

86X10037*# ISSUE 2 CATEGORY 15 RPT#: NASA-CR-3755 NAS 1.26:3755 CNT#: NAS1-15646 85/10/00 192 PAGES UNCLASSIFIED DOCUMENT DOMESTIC

UTTL: Fabrication of prepackaged superalloy honeycomb Thermal Protection System (TPS) panels

AUTH: A/BLAIR, W.; B/MEANEY, J. E.; C/ROSENTHAL, H. A.

CORP: Rohr Industries, Inc., Chula Vist, Calif.

SAP: Limited Distribution MFC: J4

CIO: UNITED STATES

MAJS: *HEAT RESISTANT ALLOYS/ *HEAT SHIELDING/ *HONEYCOMB STRUCTURES/ THERMAL PROTECTION

MINS: / FABRICATION/ INCONEL TRADEMARK)/ PANELS/ SILICON DIOXIDE/ TITANIUM

ABA: Author

ABS: High temperature materials were surveyed, and Inconel 617 and titanium were selected for application to a honeycomb TPS configuration designed to withstand 2000 F. The configuration was analyzed both thermally and structurally. Component and full sized panels were fabricated and tested t obtain data for comparison with analysis. Results verified the panel design. Twenty five panels were delivered to NASA Langly Research Center for additional evaluation. DDT: 87/11/03

....

86A18037*# ISSUE 6 PAGE 701 CATEGORY 18 85/12/00 7 PAGES UNCLASSIFIED DOCUMENT

UTTL: Verification tests of durable thermal protection system concepts

AUTH: A/SHIDELER, J. L.; B/WEBB, G. L.; C/PITTMAN, C. M. PAA: C/(NASA, Langley Research Center, Hampton, VA)

CORP: National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

CIO: UNITED STATES; (AIAA, Thermophysics Conference, 19th, Snowmass, CO, June 25-28, 1984, AIAA Paper 84-1767) Journal of Spacecraft and Rockets (ISSN 0022-4650), vol. 22, Nov.-Dec. 1985, p. 598-604. Previously cited in issue 17, p. 2439, Accession no. A84-37493.

MAJS: / *HEAT RESISTANT ALLOYS/ *HONEYCOMB STRUCTURES/ *REUSABLE HEAT SHIELDING/ *SPACE TRANSPORTATION/ *THERMAL PROTECTION

MINS: /ACOUSTIC MEASUREMENT/ AEROTHERMODYNAMICS/ ATMOSPHERIC ELECTRICITY/ CARBON-CARBON COMPOSITES/ ENVIRONMENTAL TESTS/ INCONEL (TRADEMARK)/ TITANIUM/ VACUUM TESTS/ VIBRATION TESTS

....

86A15201 ISSUE 4 PAGE 444 CATEGORY 27 85/88/00 692 PAGES UNCLASSIFIED DOCUMENT

UTTL: Annual Conference on Composites and Advanced Ceramic Materials, 9th, Cocoa Beach, FL, January 20-23, 1985, Proceedings

CIO: UNITED STATES; Conference sponsored by the American Ceramic Society. Ceramic Engineering and Science Proceedings (ISSN 0196-6219), vol. 6, July-Aug. 1985, 692 p. For individual items see A86-15202 to A86-15242.

MAJS: / *CERAMIC FIBERS/ *CERAMIC MATRIX COMPOSITES/ *CERAMICS/ *CONFERENCES/ *MECHANICAL PROPERTIES

MINS: /BRITTLE MATERIALS/ CERAMIC COATINGS/ CRACK PROPAGATION/ FINITE ELEMENT METHOD/ GRINDING (MATERIAL REMOVAL)/ HEAT SHIELDING/ MICROCRACKS/ PLASMA SPRAYING/ PROTECTIVE COATINGS/ RESIDUAL STRESS/ THERMAL DEGRADATION/ THERMAL PROTECTION/ TRIBOLOGY/ WEAR/ ZIRCONIUM OXIDES

ABA: O.C.

ABS: The present conference discusses testing methods for ceramic matrix composites, developments in ceramic fibers,

space transportation systems' thermal protection materials, ceramics for heat engines and other severe environments, thermal sprayed coatings, the development status of ceramic tribology, and the fabrication of ceramics and hard metals. Specific attention is given to the mechanical characterization of ceramic and glass matrix composites, the application of fracture mechanics to fiber composites, the degradation properties of Nicalon SiC fibers, ceramic matrix toughening, SiC/glass composite phases, ceramic composite manufacture by infiltration, and ceramic coatings for the Space Shuttle's surface insulation. Also treated are design principles for anisotropic brittle materials, ceramics for intense radiant heat applications, ceramic-coated tip seals for turbojet engines, composite production by low pressure plasma deposition, tribology in military systems, lubrication for ceramics, a systems approach to the grinding of structural ceramics, and the fabrication of inorganic foams by microwave irradiation.

....

85X10346*# ISSUE 8 CATEGORY 24 RPT#: NASA-CR-171887 NAS 1.26:171887 LTV-221RPA0081 CNT#: NAS9-17235 85/03/00 43 PAGES UNCLASSIFIED DOCUMENT DOMESTIC

UTTL: Carbon-carbon hexagonal tile thermal protection system for an aerobraked orbital transfer vehicle

TLSP: Final Report

AUTH: A/HO, T.

CORP: LTV Aerospace and Defense Co., Dallas, Tex.

SAP: Limited by ITAR

CIO: UNITED STATES

MAJS: / *AEROBRAKING/ *CARBON-CARBON COMPOSITES/ *ORBIT TRANSFER VEHICLES/ *THERMAL PROTECTION

MINS: / CERAMICS/ HEAT SHIELDING/ HIGH TEMPERATURE/ NOSE TIPS/ TILES

ABA: B.W.

ABS: Concept studies of an aerobraking orbital transfer vehicle (AOTV) are currently being conducted. For near term concept validation, a lifting brake aero-assist flight experiment (AFE), a subscale of the AOVT vehicle, will be designed and fabricated for flight demonstration. The thermal protection system of the heat shield for the AFE vehicle is the concern of this program. A maximum temperature on the heat shield surface can be expected to reach 2550 F during the aerobraking maneuvers. This high temperature calls for materials such as advanced carbon-carbon (ACC) or high performance ceramics to be used. A thermal protection system (TPS) concept using ACC was proposed. The concept uses overlapping ACC hexagonal tiles which are prestressed during the installation by mechanical fasteners and whose edges are supported on insulative blocks. This ACC hexagonal tile can survive a higher operational temperature environment than existing ceramic tiles used on the Orbiter. The hexagonal tile concept is extended to the TPS design of the nose tip area of the AFE article. Both ACC (advanced carbon-carbon) and optional RCC (reinforced carbon-carbon) systems are designed for this particular application and both are reported in this report.

....

85N12085*# ISSUE 3 PAGE 323 CATEGORY 18 RPT#: NASA-TM-86313 NAS 1.15:86313 84/09/00 12 PAGES UNCLASSIFIED DOCUMENT; Previously announced as A84-37493

UTTL: Verification tests of durable TPS concepts

AUTH: A/SHIDELER, J. L.; B/WEBB, G. L.; C/PITTMAN, C. M.

CORP: National Aeronautics and Space Administration. Langley Research Center, Hampton, Va. AVAIL.NTIS

SAP: HC A02/MF A01

CIO: UNITED STATES; Presented at the 19th AIAA Thermophys. Conf., Snowmass, Colo., 25-28

MAJS: / *HEAT RESISTANT ALLOYS/ *HONEYCOMB STRUCTURES/ *REUSABLE HEAT SHIELDING/ *SPACE TRANSPORTATION/ *THERMAL PROTECTION

MINS: /ACOUSTIC MEASUREMENT/ AEROTHERMODYNAMICS/ ATMOSPHERIC ELECTRICITY/ CARBON-CARBON COMPOSITES/ ENVIRONMENTAL TESTS/ INCONEL (TRADEMARK)/ TITANIUM/ VACUUM TESTS/ VIBRATION TESTS

ABA: Author (IAA)

ABS: Titanium multiwall, superalloy honeycomb, and Advanced Carbon-carbon (ACC) multipost Thermal Protection System (TPS) concepts are being developed to provide durable protection for surfaces of future space transportation systems. Verification tests including thermal, vibration, acoustic, water absorption, lightning strike, and aerothermal tests are described. Preliminary results indicate that the three TPS concepts are viable up to a surface temperature in excess of 2300 F.

....

85A38450*# ISSUE 17 PAGE 2506 CATEGORY 34 RPT#: AIAA PAPER 85-1056 85/06/00 14 PAGES UNCLASSIFIED DOCUMENT

UTTL: Thermal response of integral multicomponent composite thermal protection systems

AUTH: A/STEWART, D. A.; B/LEISER, D. B.; C/SMITH, M.; D/KOLODZIEJ, P. PAA: C/(NASA, Ames Research Center, Moffett Field, CA); D/(Informatics, Inc., Palo Alto, CA)

CORP: National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.; Informatics, Inc., Palo Ato, Calif.

CIO: UNITED STATES; American Institute of Aeronautics and Astronautics, Thermophysics Conference, 20th, Williamsburg, VA, June 19-21, 1985. 14 p.

MAJS: / *AEROTHERMODYNAMICS/ *FIBER COMPOSITES/ *REENTRY SHIELDING/ *SPACECRAFT REENTRY/ *THERMAL PROTECTION

MINS: /FINITE DIFFERENCE THEORY/ SPACE SHUTTLE ORBITERS/ THERMAL CONDUCTIVITY/ THERMAL INSULATION

ABA: Author

ABS: Integral-multicomponent thermal-protection materials are discussed in terms of their thermal response to an arc-jet airstream. In-depth temperature measurements are compared with predictions from a one-dimensional, finite-difference code using calculated thermal conductivity values derived from an engineering model. The effect of composition, as well as the optical properties of the bonding material between components, on thermal response is discussed. The performance of these integral-multicomponent composite materials is compared with baseline Space Shuttle insulation.

....

85A28801 ISSUE 12 PAGE 1747 CATEGORY 37 83/00/00 283 PAGES UNCLASSIFIED DOCUMENT

UTTL: ITSC '83; Proceedings of the Tenth International Thermal Spraying Conference, Essen, West Germany, May 2-6, 1983

SAP: $47

CIO: GERMANY,FEDERAL REPUBLIC OF; Conference sponsored by the International Institute of Welding. Duesseldorf, West Germany, Deutscher Verlag fuer Schweisstechnik GmbH (DVS-Berichte. Volume 80), 1983, 283 p. In English and French. No individual items are abstracted in this volume.

MAJS: / *CONFERENCES/ *PLASMA SPRAYING/ *PROTECTIVE COATINGS/ *SPRAYED COATINGS/ * THERMAL CONTROL COATINGS

MINS: /ALUMINUM/ CORROSION RESISTANCE/ ENGINE PARTS/ GAS TURBINE ENGINES/ METAL SURFACES/ THERMAL PROTECTION/ ZIRCONIUM OXIDES

ABA: I.H.

ABS: Papers presented at the 10th International Thermal Spraying Conference are assembled. Among the topics discussed are: finishing processes and alternative coating materials; quality control and the safety aspects of thermal coatings; and basic and applied research concerned with coatings and processes. Consideration is also given to: thermal barrier coatings for gas turbine components; flame sprayed surfaces for corrosion protection of offshore structures; and low-pressure plasma spraying. Some additional topics include: fire barrier coatings for protection of aluminum surfaces; the development of arc-sprayed composite coatings for

use in the 0-600 C temperature range; and the characterization of plasma-sprayed Y2O3-stabilized zirconia.

....

85A17092 ISSUE 5 PAGE 579 CATEGORY 27 84/12/00 6 PAGES UNCLASSIFIED DOCUMENT

UTTL: New coatings for high temperature materials protection

AUTH: A/BENNETT, M. J. PAA: A/(Atomic Energy Research Establishment, Materials Development Div., Didcot, Oxon, England)

CIO: UNITED KINGDOM; (American Vacuum Society, Annual Symposium on Coatings for Large-Scale Metallurgical, Optical, and Electronic Applications, 14th, Annandale, NJ, June 13, 1984) Journal of Vacuum Science and Technology B (ISSN 0734-211X), vol. 2, Oct.-Dec. 1984, p. 800-805.

MAJS: / *CERAMIC COATINGS/ *PROTECTIVE COATINGS/ *SILICON DIOXIDE/ *THERMAL PROTECTION

MINS: /CARBURIZING/ MICROANALYSIS/ NUCLEAR REACTORS/ OXIDATION/ SOL-GEL PROCESSES/ VAPOR DEPOSITION

ABA: Author

ABS: The development, characterization, and performance evaluation of two new thin (approximately equal to or less than 20 microns) ceramic coatings for high temperature materials protection is reviewed. These coatings were silica produced by two vapor deposition procedures and ceria formed by sol-gel technology. The current position regarding the use of these coatings in the UK nuclear industry is described.

....

84X74531# CATEGORY 14 RPT#: AD-B078528L FTD-ID(RS)T-1278-83 83/11/28 9 PAGES UNCLASSIFIED DOCUMENT US GOV AGENCIES

UTTL: Launch point - Plesetsk

AUTH: A/GUBAREV, V.

CORP: Air Force Systems Command, Wright-Patterson AFB, Ohio. CSS: (Foreign Technology Div.)

CIO: U.S.S.R. Transl. into ENGLISH from Pravda (USSR), no. 171(23697), 20 Jun. 1983 p 3, cols 2-8

MAJS: / *ARTIFICIAL SATELLITES/ *BOOSTER ROCKET ENGINES/ *LAUNCHING SITES

MINS: /CONSTRUCTION/ GROUND SUPPORT EQUIPMENT/ SITE SELECTION

....

84X10382*# ISSUE 8 CATEGORY 16 84/07/00 20 PAGES UNCLASSIFIED DOCUMENT DOMESTIC

UTTL: Design, fabrication and test of a multipost ACC TPS concept

AUTH: A/WEBB, G. L.; B/PITTMAN, C. M.

CORP: National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

SAP: Limited by ITAR In its Advan. in TPS and Struct. for Space Transportation Systems p 489-508 (SEE X84-10356 03-16)

CIO: UNITED STATES

MAJS: / *CARBON-CARBON COMPOSITES/ *FASTENERS/ *REUSABLE HEAT SHIELDING/ *SPACE SHUTTLES/ *THERMAL PROTECTION

MINS: / PERFORMANCE TESTS/ RADIATION EFFECTS/ STRUCTURAL DESIGN CRITERIA/ THERMAL CONDUCTIVITY/ WIND TUNNEL TESTS

ABA: Author

ABS: The design, fabrication, and testing of a multipost advanced carbon-carbon (ACC) thermal protection system (TPS) concept are discussed. The multipost ACC TPS concept uses ACC face sheets to protect packaged fibrous insulation. The ACC is attached to the vehicle with multiple standoff posts that allow thermal expansion. A

model, representing the intersection of four panels, was fabricated specifically for testing in the Langley Research Center (LaRC) 20-MW Aerothermal Arc Tunnel. It was instrumented with thermocouples between the insulation packages to determine if hot gases would penetrate the overlapping edges of the design concept. Prior to the arc-jet tests, the model was tested in a thermal vacuum chamber at LaRC to obtain a baseline thermal performance with no airflow. The model design, testing, and test data are discussed as are plans for a second-generation multipost design and test effort.

....

84X10381*# ISSUE 8 CATEGORY 16 84/07/00 16 PAGES UNCLASSIFIED DOCUMENT DOMESTIC

UTTL: Design, fabrication and test of a single-post ACC TPS concept

AUTH: A/DUNN, T. J.

CORP: National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

SAP: Limited by ITAR In NASA. Langley Research Center Advan. in TPS and Structures. for Space Transportation Systems p 473-488 (SEE X84-10356 08-16)

CIO: UNITED STATES

MAJS: / *CARBON-CARBON COMPOSITES/ *CURVED PANELS/ *SPACE SHUTTLES/ *THERMAL PROTECTION/ *TILES

MINS: /CERAMICS/ HIGH TEMPERATURE/ LIFE (DURABILITY)/ PERFORMANCE TESTS/ SYSTEM EFFECTIVENESS/ THERMAL EXPANSION

ABA: B.G.

ABS: The advantages of advanced carbon-carbon (ACC) systems over the HRSI TPS are presented: ACC is a more durable material than high-temperature reusable surface insulation (HRSI) with respect to impact and high temperature; the single-post prestressed installation is laterally rigid, allows free thermal expansion, and attenuates shock and cyclic loadings. This installation uses insulative material as part of the support system; the overlapping edge design provides for thermal expansion and eliminates gap heating and water ingestion; mechanical fastening is used for strength, reliability, and removability. An ACC cover protects the recessed fastener; and ACC TPS densities are easily tailored to suit widely varying heating rates.

....

84X10379*# ISSUE 8 CATEGORY 16 84/07/00 13 PAGES UNCLASSIFIED DOCUMENT DOMESTIC

UTTL: ACC TPS/structure applications overview

AUTH: A/ZADOROZNY, E. A.

CORP: Rockwell International Corp., Downey, Calif. CSS: (Space Transportation and Systems Group.)

SAP: Limited by ITAR In NASA. Langley Research Center Advan. in TPS and Struct. for Space Transportation Systems p 433-446 (SEE X84-10356 08-16)

CIO: UNITED STATES

MAJS: / *CARBON-CARBON COMPOSITES/ *FLIGHT TESTS/ *SPACE SHUTTLES/ *THERMAL PROTECTION

MINS: /HIGH TEMPERATURE/ REUSABLE HEAT SHIELDING/ SPACECRAFT DESIGN/ STRUCTURAL DESIGN CRITERIA/ TECHNOLOGY UTILIZATION

ABA: Author

ABS: Research, development, and testing of advanced carbon-carbon (ACC) systems have proceeded sporadically throughout the aerospace industry. These independent efforts reflect an industry realization that this material will be a fundamental element in future space applications. ACC is the only efficient hot-structure material with a long life which remains tough and durable at temperatures above 2,500 F. However, the low property allowables of early carbon-carbon systems have limited its use to specific aerospace applications. As a result of this low volume demand, the supply of certain key constituents was unreliable. The potential property improvements of ACC systems increase the probability of wider industry utilization and likewise,

safeguard the material availability for the aerospace industry. One approach to accelerate this process is to demonstrate wider hot-structure utilization by applying near-term design criteria to the retrofit and flight testing of a hot structure on operational missions of the Space Shuttle.

....

84X10376*# ISSUE 8 CATEGORY 16 84/07/00 17 PAGES UNCLASSIFIED DOCUMENT DOMESTIC

UTTL: Catalytic heating studies for metallic TPS

AUTH: A/SWANN, R. T.; B/WOOD, G. M.; C/BROWN, R. D.; D/UPCHURCH, B. R.; E/ALLEN, G.; F/MILLER, I. M.; G/HOYT, R. F.

PAA: D/(Old Dominion Univ.); E/(Old Dominion Univ.)

CORP: National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

SAP: Limited by ITAR In its Advan. in TPS and Struct. for Space Transportation Systems p 381-398 (SEE X84-10356 08-16)

CIO: UNITED STATES

MAJS: / *CATALYTIC ACTIVITY/ *FEASIBILITY ANALYSIS/ *HEAT SHIELDING/ *SPACE SHUTTLES / *THERMAL PROTECTION

MINS: /APPROXIMATION/ CALORIMETERS/ CERAMICS/ METALLIZING/ NITROGEN/ PERFORMANCE TESTS

ABA: B.W.

ABS: The catalytic heating experiment on the second Space Shuttle flight verified that the thermal protection tiles are non-catalytic to recombination of dissociated air. As a result peak surface temperatures are substantially reduced from their values for equilibrium flow. These reduced temperatures are beneficial to the ceramic heat shield on the Shuttle. However, a similar temperature reduction for metallic heat shield surfaces can make the difference between feasibility and non-feasibility of such a thermal protection system. Therefore, the development of non-catalytic surfaces is vital to the use of metallic heat shield on future transportation vehicles. The objective of this research is to acquire the basic understanding needed to get non-catalytic heat shields. The approach used in this project was to first develop the catalytic performance requirement. The goal of this requirement definition effort was to provide guidance to materials research and development. Then an apparatus was developed to measure the catalytic activity of the surface. The intent is to confirm laboratory results with arc-tunnel tests.

....

84X10375*# ISSUE 8 CATEGORY 16 84/07/00 20 PAGES UNCLASSIFIED DOCUMENT DOMESTIC

UTTL: Mechanical/radiative performance of Rene 41 in TPS application

AUTH: A/CLARK, R. K.; B/WEBB, G. L.; C/DRIES, G. A. PAA: C/(Kentron Intern.)

CORP: National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

SAP: Limited by ITAR In its Advan. in TPS and Struct. for Space Transportation Systems p 361-380 (SEE X84-10356 08-16)

CIO: UNITED STATES

MAJS: / *AEROTHERMODYNAMICS/ *EMITTANCE/ *HEAT RESISTANT ALLOYS/ *HEAT SHIELDING/ * THERMAL PROTECTION

MINS: /FABRICATION/ MORPHOLOGY/ PANELS/ SPACE TRANSPORTATION SYSTEM/ STRUCTURAL ANALYSIS

ABA: B.W.

ABS: The metallic heat shield concept is being studied for the radiatively cooled thermal protection system (TPS) for advanced reusable space transportation system vehicles and hypersonic aircraft. Nickel-base superalloys have been the focus of strong interest for heat shield applications because of their high temperature strength and oxidation resistance and because of their potential for forming high-emittance oxides on exposure to

elevated temperature. This paper presents results from aerothermal and fatigue tests of flightweight Rene 41 panels which define the residual mechanical and metallurgical characteristics of Rene 41 after exposure to simulated TPS service conditions. This paper also presents results that define the emittance and chemistry characteristics of Rene 41 after long-time exposure to TPS conditions.

....

84X10374*# ISSUE 8 CATEGORY 16 84/07/00 16 PAGES UNCLASSIFIED DOCUMENT DOMESTIC

UTTL: Aerothermal environment of an apparatus for testing curved TPS concepts

AUTH: A/ALBERTSON, C. W.

CORP: National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

SAP: Limited by ITAR In its Advan. in TPS and Struct. for Space Transportation Systems p 345-360 (SEE X84-10356 08-16)

CIO: UNITED STATES

MAJS: / *DATA BASES/ *FLOW DISTRIBUTION/ *PERFORMANCE TESTS/ *THERMAL PROTECTION/ * THERMOCOUPLES

MINS: /ANGLE OF ATTACK/ COMPUTER PROGRAMS/ FLUID DYNAMICS/ HEAT RESISTANT ALLOYS/ LIFTING BODIES/ NAVIER-STOKES EQUATION

ABA: Author

ABS: Generalized test apparatus are used in the Langley 8-Foot High-Temperature Tunnel as test beds for detailed flow studies and Thermal Protection System (TPS) concept evaluations. Previous aerothermal testing has been limited primarily to two-dimensional flow fields which are obtained using the two-dimensional (2-D) panel holder. To extend test capabilities to three dimensional flow fields, in which large surface pressure and heating-rate gradients are present at large angles of attack, a generalized test apparatus representative of the forward portion of a lifting body was designed. This apparatus, referred to as the curved surface test apparatus (CSTA) will be used for three dimensional flow studies and TPS evaluations. In support of these future efforts, an experimental data base consisting of baseline surface pressure and cold-wall heating-rate distributions was obtained for the CSTA. This data base will also be used to evaluate several computational fluid dynamics (CFD) codes.

....

84X10372*# ISSUE 8 CATEGORY 16 84/07/00 26 PAGES UNCLASSIFIED DOCUMENT DOMESTIC

UTTL: Verification tests of advanced multiwall and prepackaged metallic TPS

AUTH: A/SHIDELER, J. L.; B/WEBB, G. L.; C/PEARING, W. L.

PAA: C/(NASA, Kennedy Space Center)

CORP: National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

SAP: Limited by ITAR In its Advan. in TPS and Struct. for Space Transportation Systems p 303-328 (SEE X84-10356 08-16)

CIO: UNITED STATES

MAJS: / *INSULATION/ *SPACE TRANSPORTATION/ *THERMAL PROTECTION/ *TITANIUM

MINS: /HEAT RESISTANT ALLOYS/ SANDWICH STRUCTURES/ VIBRATION/ WIND TUNNEL TESTS

ABA: Author

ABS: Titanium multiwall and superalloy honeycomb TPS concepts have been developed to provide thermal protection for future space transportation systems for application at surface temperatures between 700 F and 2000 F. The multiwall concept consists of layers of dimpled titanium foil connected together dimple-to-dimple, and the superalloy honeycomb concept consists of an outer Inconel 617 honeycomb sandwich, fibrous insulation, and an

inner titanium honeycomb sandwich. The edges of each concept are covered with beaded closures, thus forming discrete panels nominally 12 inches square. This paper reviews verification tests aimed at establishing a limited data base from which the designers of future entry vehicles can evaluate the applicability of these concepts to their vehicles. Preliminary results from thermal, wind tunnel, vibration, acoustic, water absorption, and lightning strike tests are presented.

....

84X10371*# ISSUE 8 CATEGORY 16 84/07/00 41 PAGES UNCLASSIFIED DOCUMENT DOMESTIC

UTTL: Manufacturing experiences for advanced multiwall and prepackaged metallic TPS

AUTH: A/BLAIR, W.

CORP: Rohr Industries, Inc., Chula Vista, Calif. CSS: (Research and Development Engineering Div.)

SAP: Limited by ITAR In NASA. Langley Research Center Advan. in TPS and Struct. for Space Transportation Systems p 261-302 (SEE X84-10356 08-16)

CIO: UNITED STATES

MAJS: / *MANUFACTURING/ *PANELS/ *REENTRY VEHICLES/ *SILICON DIOXIDE/ *THERMAL PROTECTION/ *TITANIUM

MINS: / COMPUTER PROGRAMS/ FABRICATION/ SANDWICH STRUCTURES/ STRUCTURAL ANALYSIS / THERMAL CONDUCTIVITY

ABA: B.W.

ABS: A titanium multiwall panel was designed and fabricated for areas of a reusable space vehicle where re-entry temperatures range between 450 K (350 F) and 811 K (1000 F). A superalloy titanium silica sandwich panel was designed and fabricated for areas where the re-entry temperatures range between 811 K (1000 F) and 1366 K (2000 F). A material survey was conducted. Computer structural and thermal analyses were performed. The materials were checked for emittance. Specimens were tested for elongation, yield, and ultimate strength. Sandwich specimens were tested in flatwise face tension, compression, and beam flexure. These tests were conducted at room and elevated temperatures. Pressure and thermal conductivity tests were performed on full-size panels. In this paper, only the design and manufacturing experiences will be discussed.

....

84X10366*# ISSUE 8 CATEGORY 16 84/07/00 14 PAGES UNCLASSIFIED DOCUMENT DOMESTIC

UTTL: Flexible thermal protection materials

AUTH: A/SAWKO, P. M.

CORP: National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

SAP: Limited by ITAR In NASA. Langley Research Center Advan. in TPS and Struct. for Space Transportation Systems p 179-192 (SEE X84-10356 08-16)

CIO: UNITED STATES

MAJS: / *CERAMICS/ *FABRICATION/ *FLEXIBILITY/ *INSULATION/ *REUSABLE HEAT SHIELDING / *THERMAL PROTECTION

MINS: /ALUMINUM BORON COMPOSITES/ BORON COMPOUNDS/ FELTS/ SILICON CARBIDES/ YARNS

ABA: Author

ABS: The fabrication of advanced flexible ceramic TPS materials is described and some accomplishments are summarized. Use of aluminoborosilicate fabrics and threads as the outer surface for flexible TPS is feasible according to these preliminary fabrication studies. Greater strength retention at higher temperature appears possible with this class of ceramic yarns. Three-dimensional woven structures from silica yarn were fabricated and results of a preliminary aeroacoustic screening test in the Ames 2- by 2-foot transonic wind tunnel were obtained. Additional fabrication studies of three-dimensional core structures using aluminoborosilicate and silicon carbide yarns are under way utilizing varied core geometry construction with both rigid and flexible ceramic fillers. This second generation material is designated as tailorable advanced blanket insulation.

....

84X10356*# ISSUE 8 CATEGORY 16 RPT#: NASA-CP-2315 L-15790 NAS 1.55:2315 84/07/00 516 PAGES UNCLASSIFIED DOCUMENT DOMESTIC

UTTL: Advances in TPS and Structures for Space Transportation Systems

AUTH: A/KELLY, H. N.; B/GARDNER, J. E. PAT: A/comp.; B/comp.

CORP: National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

SAP: Limited by ITAR

CIO: UNITED STATES; Symp. held in Hampton, Va., 13-15 Dec. 1983

MAJS: / *CONFERENCES/ *SPACE SHUTTLE ORBITERS/ *SPACE TRANSPORTATION SYSTEM/ * SPACECRAFT STRUCTURES/ *THERMAL PROTECTION

MINS: / AEROTHERMODYNAMICS/ CARBON-CARBON COMPOSITES/ CERAMICS/ COMPOSITE STRUCTURES/ METALS/ STRUCTURAL ENGINEERING

ANN: Flight experiences with the Space Shuttle orbiter thermal protection system are described and evaluated, and research on new concepts in metallic, ceramic, and advanced carbon-carbon TPS and structures is presented. Advanced and alternate configurations and missions for next-generation space transportation systems and issues and technology needs are discussed.

....

84N32505*# ISSUE 22 PAGE 3554 CATEGORY 26 RPT#: NASA-TM-86293 NAS A11.15:86293 AA-84-1768 84/08/00 9 PAGES UNCLASSIFIED DOCUMENT

UTTL: Response of Inconel 617 superalloy to combined ground-based and SIS reentry exposure

AUTH: A/CLARK, R. K.; B/UNNAM, J. PAA: B/(Analytical Service and Materials, Inc., Tabb, Va.)

CORP: National Aeronautics and Space Administration. Langley Research Center, Hampton, Va. AVAIL.NTIS

SAP: HC A02/MF A01

CIO: UNITED STATES; Presented at the 19th Thermophys. Conf., Snowmass, Colo., 25-28 Jun. 1984

MAJS: / *HEAT RESISTANT ALLOYS/ *HIGH TEMPERATURE/ *HYPERSONIC REENTRY/ *INCONEL (TRADEMARK)/ *NICKEL

MINS: /BRINES/ EMITTANCE/ ENVIRONMENT EFFECTS/ HEAT SHIELDING/ OXIDATION/ THERMAL PROTECTION

ABA: Author

ABS: Inconel 617 is a nickel-based superalloy which is being considered for heat-shield applications because of its high-temperature strength, good oxidation resistance and high emittance of oxidized surfaces. While the effects of simulated reentry conditions on emittance and oxidation of Inconel 617 have been studied, the combined effects of the ground-based environment with sea salt exposure and the reentry environment have not been evaluated. Experimental results are presented to show the effects of environmental simulation including ground-based and reentry exposure on the emittance and oxidation of Inconel 617. Specimens were exposed to simulated reentry at a surface temperature of 2000 F in the Langley Research Center Hypersonic Materials Environmental Test System (HYMETS) Facility with and without alternate exposures to an atmospheric seashore environment or a laboratory sea salt environment. This paper presents emittance, mass loss, oxide chemistry, and alloy composition data for the specimens.

....

84N24709# ISSUE 15 PAGE 2284 CATEGORY 20 RPT#: AD-A139903 AFRPL-TR-83-059 CNT#: AF PROJ. 5730 84/02/00 118 PAGES UNCLASSIFIED DOCUMENT

UTTL: Low-cost insulator

TLSP: Final Report, Nov. 1981 - Feb. 1984

AUTH: A/TOSCANO, E. B.

CORP: Air Force Rocket Propulsion Lab., Edwards AFB, Calif. AVAIL.NTIS

SAP: HC A06/MF A01

CIO: UNITED STATES

MAJS: / *ABLATIVE MATERIALS/ *THERMAL CONTROL COATINGS/ *THERMAL INSULATION/ * THERMAL PROTECTION

MINS: / CARBON/ CORROSION RESISTANCE/ CURING/ EROSION/ EXHAUST GASES/ FILLERS/ FORMULATIONS/ HIGH TEMPERATURE/ LOW COST/ MAINTENANCE/ POWDERED ALUMINUM/ SANDS/ SILICON DIOXIDE/ SOLID PROPELLANT ROCKET ENGINES/ SOLID PROPELLANTS

ABA: GRA

ABS: Ablative materials protect aerodynamic surfaces, propulsion structures, and ground equipment from the very high temperatures and the velocity of the gases in the exhaust. This paper describes current efforts to evaluate an ablative coating based on a low-cost polymer and a low-cost filler. The objective was to develop a low-cost, ablative/insulating material for routine application to protect costly test facilities. Experiments were conducted at the AFRPL using the standard 15-pound Ballistic Test and Evaluation System (BATES) solid propellant rocket motors containing aluminized propellants. This type of propellant produces an erosive exhaust gas which is the best condition for evaluating the ablative coating formulations. Other motors were also used for evaluation purposes, such as Peacekeeper Stages I, II, and III; Short-Length Super High Internal Pressure-Producing Orifice (HIPPO); Super BATES; and the SIS-5 Space Shuttle launch. Ablative samples were tested, evaluated, and compared to commercially available ablative materials under the same conditions. It was found that the low-cost ablative/insulating materials withstood the high temperature exhaust as well as, or better than, the commercially available ablative products. Using the best candidate, the Low-Cost Insulator in the one-gallon mix, cost approximately $13.00 compared to $147.00 for the same amount of the commercially available ablative material. The AFRPL ablative material can be processed in the field for easy application and the material cures at ambient temperature.

....

84A47046# ISSUE 23 PAGE 3403 CATEGORY 37 RPT#: ASME PAPER 84-GT-292 CNT#: NAG3-164 NCC3-27 84/06/00 5 PAGES UNCLASSIFIED DOCUMENT

UTTL: Acoustic emission evaluation of plasma-sprayed thermal barrier coatings

AUTH: A/BERNDT, C. C.

PAA: A/(NASA, Lewis Research Center, Cleveland, OH)

CORP: National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

CIO: UNITED STATES; American Society of Mechanical Engineers, International Gas Turbine Conference and Exhibit, 29th, Amsterdam, Netherlands, June 4-7, 1984. 5 p.

MAJS: / *ACOUSTIC EMISSION/ *PERFORMANCE TESTS/ *PLASMA SPRAYING/ *SPRAYED COATINGS / *THERMAL CONTROL COATINGS/ *THERMAL PROTECTION

MINS: / ADHESION TESTS/ CERAMIC COATINGS/ FAILURE ANALYSIS/ METAL COATINGS/ THERMAL CYCLING TESTS

ABA: Author

ABS: Acoustic emission techniques have recently been used in a number of studies to investigate the performance and failure behavior of plasma-sprayed thermal barrier coatings. Failure of the coating is a complex phenomena, especially when the composite nature of the coating is considered in the light of possible failure mechanisms. Thus it can be expected that both the metal and ceramic components (i.e., the bond coat and ceramic overlay) of a composite thermal protection system influence the macroscopic behavior and performance of the coating. The aim of the present work is to summarize the 'state-of-the-art' in terms of this initial work and indicate where future progress may be made.

....

84A42651 ISSUE 20 PAGE 2871 CATEGORY 26 84/00/00 371 PAGES UNCLASSIFIED DOCUMENT

UTTL: High-temperature protective coatings; Proceedings of the Symposium, Atlanta, GA, March 7, 8, 1983

AUTH: A/SINGHAL, S. C. PAA: A/(Westinghouse Research and Development Center, Pittsburgh, PA) PAT: A/ED.

SAP: Members, $32.; nonmembers, $50

CIO: UNITED STATES; Symposium sponsored by the Metallurgical Society of AIME and American Society for Metals. Warrendale, PA, Metallurgical Society of AIME, 1984, 371 p. For individual items see A84-42652 to A84-42668.

MAJS: / *CONFERENCES/ *HEAT RESISTANT ALLOYS/ *HOT CORROSION/ *METAL COATINGS/ * NONDESTRUCTIVE TESTS/ *PROTECTIVE COATINGS/ *THERMAL CONTROL COATINGS

MINS: / ALUMINUM ALLOYS/ CERAMIC COATINGS/ CHROMIUM ALLOYS/ COBALT ALLOYS/ CORROSION RESISTANCE/ CORROSION TESTS/ ENVIRONMENTAL TESTS/ GAS TURBINE ENGINES/ NICKEL ALLOYS/ PLASMA SPRAYING/ SPRAYED COATINGS

ABA: O.C.

ABS: The present conference considers gas turbine airfoil protective coatings deposited by electron beam physical vapor deposition, vapor phase aluminization, and laser-treated plasma spraying, as well as interdiffusion effects on oxidation/resistant coatings for advanced single crystal superalloys, acoustic emissions from oxide cracking during alloy oxidation, and the optimization of MCr alloy coating compositions for marine gas turbines. Also discussed are the microstructural characterization of a service-exposed, CoCrAlY overlay coating, the corrosion failure of a gas turbine aluminide coating, steels with aluminized coatings, CVD-SiC coatings for ceramic heat exchanger tubes, the degradation of ceramic thermal barrier coatings, and the erosion of hard metal coatings.

....

84A41928 ISSUE 20 PAGE 2862 CATEGORY 18 83/00/00 102 PAGES UNCLASSIFIED DOCUMENT

UTTL: Review of German work on controlled re-entry technology

AUTH: A/WUEST, W.

PAA: A/(Deutsche Forschungs- und Versuchsanstalt fuer Luftund Raumfahrt, Institut fuer Experimentelle Stroemungsmechanik, Goettingen, West Germany)

CIO: GERMANY,FEDERAL REPUBLIC OF; Progress in Aerospace Sciences (ISSN 0376-0421), vol. 20, no. 4, 1983, p. 217-318.

MAJS: / *AERODYNAMIC CHARACTERISTICS/ *AERODYNAMIC HEAT TRANSFER/ *HYPERVELOCITY FLOW/ *SPACECRAFT REENTRY/ *THERMAL PROTECTION/ *WIND TUNNEL TESTS

MINS: / AERODYNAMIC STABILITY/ COMPUTER PROGRAMS/ HYPERSONIC WIND TUNNELS/ LIFTING BODIES/ REENTRY SHIELDING/ SUPERSONIC FLOW/ TRANSONIC WIND TUNNELS / VISCOUS FLOW/ WEST GERMANY

ABA: T.K.

ABS: The results of studies on hypersonic aerodynamics and reentry technology carried out by FRG aerospace firms, government institutions, and university institutes from the beginning of the National Space Program in 1962 through the end of the activities of the Arbeitsgruppe Rueckkehrtechnologie in 1975 are summarized and illustrated with photographs, drawings, graphs, and diagrams. The aerodynamic problems of controlled reentry are discussed; the computer programs developed to design reentry-body configurations are described; and problems in hypervelocity low-density flow, aerodynamic heat transfer, and the design of heat-protection systems are considered. The development of the various test configurations is traced, and wind-tunnel and free-flight data are presented.

....

84A37496*# ISSUE 17 PAGE 2458 CATEGORY 27 RPT#: AIAA PAPER 84-1770 84/06/00 10 PAGES UNCLASSIFIED DOCUMENT

UTTL: High temperature performance of flexible thermal protection materials

AUTH: A/SAVAGE, R. T.; B/LOVE, W.; C/BLOETSCHER, F.

PAA: A/(Boeing Aerospace Co., Seattle, WA); B/(NASA, Ames Research Center, Moffett Field, CA); C/(Goodyear Aerospace Corp., Akron, OH)

CORP: Boeing Aerospace Co., Seattle, Wash.; National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.; Goodyear Aerospace Corp., Akron, Ohio.

CIO: UNITED STATES; American Institute of Aeronautics and Astronautics, Thermophysics Conference, 19th, Snowmass, CO, June 25-28, 1984. 10 p.

MAJS: / *CONVECTIVE HEAT TRANSFER/ *FABRICS/ *FLEXIBLE SPACECRAFT/ *HIGH TEMPERATURE TESTS/ *THERMAL PROTECTION

MINS: / AEROASSIST/ FELTS/ FIBERS/ HEAT FLUX/ ORBIT TRANSFER VEHICLES/ REUSABLE HEAT SHIELDING/ STAGNATION PRESSURE/ SWEAT COOLING/ THERMAL INSULATION

ABA: Author

ABS: Aero convective tests of several flexible thermal protection system (FTPS) concepts were conducted in the NASA Ames Research Center 20 MW arcjet aero heating wind tunnel. The concepts consisted of quilted insulation blankets with next nicalon fabrics. The specimens were subjected to convective heat fluxes ranging from 7 to 35 Btu/per sq ft per sec at stagnation pressures of .005 to .02 atm. Specimens were tested both with and without transpiration cooling. Results indicated that both the nextel and nicalon fabrics offer the potential for higher temperature applications than current FTPS, and nicalon appears to be capable of withstanding temperatures well above 2500 degrees F with minimal degradation.

....

84A37494*# ISSUE 17 PAGE 2456 CATEGORY 26 RPT#: AIAA PAPER 84-1768 84/06/00 8 PAGES UNCLASSIFIED DOCUMENT

UTTL: Response of Inconel 617 superalloy to combined ground-based and STS reentry exposure

AUTH: A/CLARK, R. K.; B/UNNAM, J.

PAA: A/(NASA, Langley Research Center, Hampton,VA); B/(Analytical Services and Materials, Inc., Tab, VA)

CORP: National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.; Analytical Services and Materials, Inc., Tabb, Va.

CIO: UNITED STATES; American Institute of Aeronautics and Astronautics, Thermophysic Conference, 19th, Snowmass, CO, June 25-28, 1984. 8 p.

MAJS: / *ENVIRONMENTAL TESTS/ *HEAT RESISTANT ALLOYS/ *HYPERSONIC REENTRY *THERMAL PROTECTION

MINS: /EMITTANCE/ INCONEL (TRADEMARK)/ OXIDATION RESISTANCE/ REFLECTANCE/ REUSABLE SPACECRAFT/ SEA WATER/ SPECTRAL EMISSION

ABA: Author

ABS: Inconel 617 is a nickel-based superalloy which is being considered for heat-shield applications because of its high-temperature strength, good oxidation resistance and high emittance of oxidized surfaces. While the effects of simulated reentry conditions on emittance and oxidation of Iconel 617 have been studied, the combined effects of the ground-based environment with sea salt exposure and the reentry environment have not been evacuated. Experimental results are presented to show the effects of environmental simulation including ground-based and reentry exposure on the emittance and oxidation of Inconel 617. Specimens wee exposed o simulated reentry at a surface temperature o 2000 F in the Langley Research Center Hypersonic Materials Environmental Test System (HYMETS) Facility with and without alternate exposures to an atmospheric seashore environment or a laboratory sea salt environment. This paper presents emittance, mass loss, oxide chemistry, and alloy composition data for the specimens.

....

84A37493*# ISSUE 17 PAGE 2439 CATEGORY 18 RPT#: AIAA PAPER 84-1767 84/06/00 11 PAGES UNCLASSIFIED DOCUMENT

UTTL: Verification tests of durable TPS concepts

AUTH: A/SHIDELER, J. L.; B/WEBB, G. L.; C/PITTMAN, C. M.

PAA: C/(NASA, Langley Research Center, Loads and Aeroelasticity Div., Hampton, VA)

CORP: National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

CIO: UNITED STATES; American Institute of Aeronautics and Astronautics, Thermophysics Conference, 19th, Snowmass, CO, June 25-28, 1984. 11 p.

MAJS: / *HEAT RESISTANT ALLOYS/ *HONEYCOMB STRUCTURES/ *REUSABLE HEAT SHIELDING/ *SPACE TRANSPORTATION/ *THERMAL PROTECTION

MINS: /ACOUSTIC MEASUREMENT/ AEROTHERMODYNAMICS/ ATMOSPHERIC ELECTRICITY/ CARBON-CARBON COMPOSITES/ENVIRONMENTAL TESTS/ INCONEL (TRADEMARK)/ TITANIUM/ VACUUM TESTS/ VIBRATION TESTS

ABA: Author

ABS: Titanium multiwall, superalloy honeycomb, and Advanced Carbon-Carbon (ACC) multipost Thermal Protection System (TPS) concepts are being developed to provide durable protection for surfaces of future space transportation systems. Verification tests including thermal, vibration, acoustic, water absorption, lightning strike, and aerothermal tests are described. Preliminary results indicate that the three TPS concepts are viable up to a surface temperature in excess of 2300 F.

....

82N23262*# ISSUE 14 PAGE 1907 CATEGORY 18 RPT#: NASA-CR-3548 NAS 1.26:3548 STS-81-0549-1 CNT#: NAS1-16302 82/04/00 66 PAGES UNCLASSIFIED DOCUMENT

UTTL: An assessment of alternate thermal protection systems for the Space Shuttle orbiter, volume 1 TLSP: Final Executive Summary

AUTH: A/HAYS, D.

CORP: Rockwell International Corp., Downey, Calif. AVAIL.NTIS

SAP: HC A04/MF A01

CIO: UNITED STATES; Washington NASA

MAJS: / *ABLATIVE MATERIALS/ *CARBON-CARBON COMPOSITES/ *HEAT RESISTANT ALLOYS/ * SPACE SHUTTLE ORBITERS/ *THERMAL PROTECTION/ *TITANIUM ALLOYS

MINS: / COST ANALYSIS/ PROJECT PLANNING/ SPACECRAFT DESIGN/ STRUCTURAL DESIGN CRITERIA/ TECHNOLOGY ASSESSMENT/ THERMAL INSULATION

ABA: S.L.

ABS: Alternate thermal protection system (TPS) concepts to the Space Shuttle Orbiter were assessed. Metallic, ablator, and carbon-carbon concepts which are the result of some previous design, manufacturing and testing effort were considered. Emphasis was placed on improved TPS durability, which could potentially reduce life cycle costs and improve Orbiter operational characteristics. Integrated concept/orbiter point designs were generated and analyzed on the basis of Shuttle design environments and criteria. A merit function evaluation methodology based on mission impact, life cycle costs, and risk was developed to compare the candidate concepts and to identify the best alternate. Voids and deficiencies in the technology were identified, along with recommended activities to overcome them. Finally, programmatic plans, including ROM costs and schedules, were developed for all activities required to bring the selected alternate system up to operational readiness.

....

82A31896*# ISSUE 15 PAGE 2357 CATEGORY 16 RPT#: AIAA PAPER 82-0899 1282/06/00 PAGES UNCLASSIFIED DOCUMENT

UTTL: Assessment of alternate thermal protection systems for the Space Shuttle Orbiter

AUTH: A/KELLY, H. N.; B/WEBB, G. L. PAA: B/(NASA, Langley Research Center, Loads and Aeroelasticity Div., Hampton, VA)

CORP: National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

CIO: UNITED STATES; American Institute of Aeronautics and Astronautics and American Society of Mechanical Engineers, Joint Thermophysics, Fluids, Plasma and Heat Transfer Conference, 3rd, St. Louis, MO, June 7-11, 1982, AIAA, 12 pages

MAJS: / *REUSABLE HEAT SHIELDING/ *SPACE SHUTTLE ORBITERS/ *SPACECRAFT SHIELDING/ * TECHNOLOGY ASSESSMENT/ *THERMAL PROTECTION

MINS: /CARBON-CARBON COMPOSITES/ CERAMICS/ LIFE CYCLE COSTS/ TILES

ABA: D.L.G.

ABS: Technical aspects of the alternate thermal protection system (TPS) study for the Shuttle Orbiter are reviewed, and a status report on alternate TPS technology developments is presented. Mission impact, life cycle costs and risks, and selected candidate concepts are identified. The best system would consist of mechanically attached metallic and carbon-carbon TPS concepts employing a titanium multiwall prepackaged concept at temperatures below 1000 F, a superalloy honeycomb prepackaged concept at temperatures between 1000-1800 F, and an advanced carbon-carbon multipost standoff concept above 1800 F. Alternative concepts offer significant improvements in durability and are mass competitive with current ceramic tile reusable surface insulation.

....

No: S4 **Title:** No Ordnance

Operations Requirement:

Eliminate all ordnance devices. See the following items for directly related additional criteria:

S4.1 Independent Weapon Destruct
S4.2 Laser Ignition
S4.3 Non-pyrotechnic Separation

Rationale:

Eliminate all ordnance devices or provide ordnance which is inherently safe for handling purposes. Eliminate or drastically reduce "area clear" for ordnance.

The following data are provided for processing of STS-31, orbiter Atlantis, launched November 26, 1985 (flight 23). Data source is the Shuttle II Data Base Development prepared by SPC sub-contractor Pan Am World Services, Inc., dated July 24, 1987.

SHEDULED MAINTENANCE, SYSTEM 55,
PYROTECHNICS/RANGE SAFETY

OPF OPERATIONS

TASK	MANHOURS
Technician	292
Engineering	260
Safety	23
Quality	111
PP&C	64
Support	540
Logistics	155
Overhead	123
Total	1,568

NOTES

1. This data for STS-31 only
2. Review of OMI data indicates 292 technician manhours/64 clock hours for an average of 4.56 technicians.
3. Total MHs/technican MHs indicates a ratio of 5.37 for a total SPC headcount of 24.5 supporting this function in the OPF.
4. Landing operations dwell time 4 days
   OPF dwell time 27 days
   VAB dwell time 4 days
   PAD dwell time 15 days
5. Orbiter Challenger was in parallel processing during this period.

VAB INTEGRATION

Technician MHRS	242	
OMI total time, hrs.	38	
Average number of techs.	6.37	
Ratio of total pyro MH/tech MH	5.82	
Total headcount supporting pyro for 38 hrs.	37	(1,406 MHRS)

PAD OPERATIONS

Technican MHRS	2,244	
OMI total time, hrs.	34	
Average number of techs.	66	
Ratio of total pyro MH/tech MH	5.65	
Total headcount supporting pyro for 34 hrs.	373	(12,682 MHRS)

OMI DEFINITION

The following presentation of major pyrotechnic/range safety tasks is intended to provide further insight into the direct hands-on impact of those hazardous systems. The indirect impact (numerous "area-clear" periods) has not been quantified by this study, but is known to be highly significant.

SCHEDULED MAINTENANCE

OPF OPERATIONS

	TIME	TECHS	MHRS
V5012 - Ordnance Installation and Checkout			
A. Pre-Operations-Pyro Flight Cable Installation	8	2	16
This task prepares the orbiter for ordnance installation in the orbiter processing facility.			
B. Ground Support Equipment Cable Installation-Aft	8	2	4
This task installs a ground support equipment cable assembly to support installation and electrical connection of pyrotechnic ordnance in the aft section of the orbiter.			
C. Install Aft Separation Nuts	16	2	32
This task installs new separation nuts in the orbiter aft fuselage.			
D. Forward External Tank Fittings and Yoke Assembly Installation	16	8	128
This task installs the external tank attach fittings and yoke assembly on the orbiter forward fuselage.			
E. Power Down Ordnance Installation and Electrical Connection	8	10	80
This task installs and electrically connects orbiter ordnance.			
F. Power on Pyro Initiator Control Test Stand/Ground Support Installation	8	4	32
This task installs ground support equipment as required to support pyro initiator control system testing.			
Totals	64		292

VAB INTEGRATON

	TIME	TECH MHRS
V5029 - Oribter Pyro Installation Installs and electrically connects Orbiter pyro separation devices in the VAB and at the Pads. A stray voltage tester is used during these operations. Pyrotechnic devices are installed to separate the external tank and umbilicals from the Orbiter in flight. This document also disconnects and removes pyro devices if necessary.	24	153
V5027 - TSM Pyro Installation and Removal Procedures for pyrotechnic devices used at the mobile launch platform (MLP) tail service masts (TSM). They cover stray voltage checks, the installation and checkout of pyros, and the removal of expended pyros.	3	19
T1099A - Connect ET Shuttle Range Safety System flight battery	1	6
T1251A - ET tumble system checks	3	19
S1015A - SRB Shuttle Range Safety System checks and safe/arm rotation	5	32
T1499A - ET Shuttle Range Safety System stray voltage checks	2	13
Totals:	38	242

PAD OPERATIONS

	TIME	TECH MHRS
S5009A - Ordnance Installation - Part 1A	8	408
S5009B - Ordnance Installation - Part 1B	6	816
S5009C - Final Ordnance Installation/Connection, Installs, electrically connects, and performs resistance checks of Pyro Ground Support System devices which will be installed at the Pad. Shuttle Safe + Arm (S&A) devices are electrically connected and circuit resistance checks performed.	20	1,020
Totals:	34	2,244

Sample Concept:

Eliminate explosive ignition devices: replace pyrotechnics with lasers. (See S4.2).

Explosive release and separation devices: replace with electromechanical and Nitinol initiated devices. (See S4.3)

Explosive range safety devices: eliminate by using military weapon systems to destroy errant vehicles. Use vehicle-borne beacon to assure identification and assist weapon. (See S4.1).

Technology Requirement:

Development only.

Technology References:

NASA/RECON: 86X70834, 86N27356, 86A23512, 85N13959, 85A47011, 84A42759, 82N72580, 82N19033, 80X73875

Conclusions:

The above rationale shows that technicians supported mission STS-31 pyrotechnics/range safety for a total of 2,778 MH. A maximum shuttle launch rate of 8 per year was achieved in FY85, indicating the possibiility of 22,224 technician MHs per year for pyrotechnic support. The reference Pan Am data indicates the SPC apportioned ratio of total pyro MHs to tech MHs is 5.64. This implies that total annual MH's in support of pyro/range safety is 22,224 x 5.64 = 125,343 MHs or 60 manyears/year.

Within limitations of the contract-wide headcount apportionment method, it appears possible that total elimination of pyrotechnic/range safety devices can reduce the shuttle-equivalent headcount by 60 persons. The ground processing timeline of 50 days would also conceivably benefit by recapture of the serial portion of the 163 total OMI operational hours noted above; i.e., perhaps as much as 1 day per flow.

86X70834# CATEGORY 37 RPT#: AD-B095018L AD-E950740 AMSMI/RL-85-2-TR 85/07/00 21 PAGES UNCLASSIFIED DOCUMENT US GOV AGENCIES

UTTL: The role of robotics in reducing exposure to hazardous environments

AUTH: A/YOUNG, V.

CORP: Army Missile Command, Redstone Arsenal, Ala. CSS: (Structures Directorate.)

MFC: 00

CIO: UNITED STATES

MAJS: / *ARTIFICIAL INTELLIGENCE/ *EXPOSURE/ *HAZARDS/ *MANIPULATORS/ *MECHANICAL DRIVES/ *ROBOTICS

MINS: / AUTOMATIC CONTROL/ DECONTAMINATION/ ELECTRIC MOTORS/ ENVIRONMENTS/ FIBER OPTICS/ FIRE CONTROL/ HUMAN RESOURCES/ MECHANICAL DRIVES/ MILITARY OPERATIONS/ MILITARY TECHNOLOGY/ MINES (ORDNANCE)/ PROPULSION/ REQUIREMENTS/ RISK/ ROCKET ENGINES/ SYSTEM EFFECTIVENESS

....

86N27356# ISSUE 18 PAGE 2861 CATEGORY 18 85/12/00 5 PAGES UNCLASSIFIED DOCUMENT DCAF E003091

UTTL: Features of the solar array drive mechanism for the Space Telescope

AUTH: A/HOSTENKAMP, R. G.

CORP: Dornier-Werke G.m.b.H., Friedrichshafen (West Germany). AVAIL.NTIS

SAP: HC A15/MF A01; ESA, Paris FF 150 or $18 Member States, AU, CN, NO (+20% others); In ESA Second European and Space Mechanisms and Tribology Symposium p 13-17 (SEE N86-27353 18-18)

CIO: GERMANY, FEDERAL REPUBLIC OF

MAJS: / *HUBBLE SPACE TELESCOPE/ *MECHANICAL DRIVES/ *SOLAR ARRAYS

MINS: / DATA TRANSMISSION/ ELECTRIC POWER TRANSMISSION/ NITINOL ALLOYS/ SYSTEMS ENGINEERING/ TORQUE

ANN: Spacecraft mechanisms; motors and actuators; tribology; space stations; and mechanism analysis and testing were discussed.

ABA: ESA

ABS: The Solar Array Drive Mechanism for the Space Telescope is described. Power and signal transfer is achieved by a flexible wire harness for which the chosen solution, consisting of 168 standard wires, is described. The torque performance data of the harness over its temperature range is presented. The off load system which protects the bearings from the launch loads is released by a trigger made from Nitinol, a memory alloy. The benefits of memory alloy and the caveats for the design are discussed. The design of the off load is outlined and test experience reported.

....

86A23512 ISSUE 9 PAGE 1168 CATEGORY 20 RPT#: SAE PAPER 851322 PA85/07/00 6 GES UNCLASSIFIED DOCUMENT

UTTL: Space applications of Nitinol heat engines

AUTH: A/HAYASHIDA, K. H., JR.; B/CADY, E. C.; C/MCNICHOLS, J. L., JR.; D/GALIK, B. R., JR. PAA: A/(Los Alamitos High School, CA); D/(McDonnell Douglas Astronautics Co., Huntington Beach, CA)

CIO: UNITED STATES; AIAA, SAE, ASME, AIChE, and ASMA, Intersociety Conference on Environmental Systems, 15th, San Francisco, CA, July 15-17, 1985. 6 p.

MAJS: / *ENERGY CONVERSION/ *NITINOL ALLOYS/ *SHAPE MEMORY ALLOYS/ *SOLAR HEATING/ * SPACE STATION POWER SUPPLIES/ *SPACECRAFT POWER SUPPLIES/ *WASTE ENERGY UTILIZATION

MINS: /IRRADIATION/ NICKEL ALLOYS/ RADIANT COOLING/ SPACE STATIONS/ TITANIUM ALLOYS/ WASTE HEAT

ABA: Author

ABS: The Nitinol Heat Engine (NHE) uses a shape-memory alloy of nickel and titanium to convert thermal energy directly to mechanical power and through a generator, to electricity. An NHE was analyzed and designed to produce power from solar irradiation in space, with radiative cooling to a deep-space heat sink. A model NHE was built and tested in a space chamber simulating the radiation and space environment, and produced results agreeing with performance predictions. Other space NHE using Space Station waste heat are also discussed. Such space NHE are demonstrated to be cost-competitive with photovoltaic cells as a source for space power.

....

85N13959# ISSUE 5 PAGE 619 CATEGORY 26 RPT#: BMFT-FB-W-84-032 ISSN-0170-133 84/09/00 57 PAGES In GERMAN; ENGLISH summary; UNCLASSIFIED DOCUMENT DCAF E002631

UTTL: Nitinol devices, phase 2, integration of slip ring system and tracking mechanism with memory drive

TLSP: Final Report, Mar. 1980

AUTH: A/JORE, J.; B/EISS, H. G.

CORP: Krupp (Fried.) G.m.b.H, Essen (West Germany). CSS: (Krupp Forschungsinst.) AVAIL.NTIS

SAP: HC A04/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 12

CIO: GERMANY,FEDERAL REPUBLIC OF; Bundesministerium fuer Forschung und Technologie Sponsored by Bundesministerium fuer Forschung und Tecnologie

AJS: / *ENERGY CONVERSION/ *MECHANICAL DRIVES/ *NITINOL ALLOYS/ *SLIP CASTING

MINS: / ANGULAR VELOCITY/ RING STRUCTURES/ SHAPE MEMORY ALLOYS

ABA: Author (ESA)

ABS: Reversible memory effects of NiTi alloys are treated. A tracking mechanism with memory drive elements was manufacture and tested, and integrated in the slip ring system. Results show that no gearing is required to produce small angular steps (0.3 arc deg.) because the memory drive elements themselves perform this task. A slip ring tracking mechanism module is available.

....

85A47011 ISSUE 22 PAGE 3292 CATEGORY 38 CNT#: W-7405-ENG-82 84/00/00 7 PAGES UNCLASSIFIED DOCUMENT

UTTL: Inference of compressive stresses at joined interfaces using ultrasonic reflectivity

AUTH: A/THOMPSON, D. O.; B/REHBEIN, D. K.; C/SKILLINGS, B. J.; D/SMITH, J. F. PAA: D/(DOE, Ames Laboratory, Ames, IA)

CIO: UNITED STATES; IN: Nondestructive methods for material property determination; Proceedings of the Symposium, Hershey, PA, April 6-8, 1983 (A85-47001 22-38). New York, Plenum Press, 1984, p. 171-177.

MAJS: / *COMPRESSION LOADS/ *FASTENERS/ *JOINTS (JUNCTIONS)/ *NITINOL ALLOYS/ *STRESS ANALYSIS/ *ULTRASONIC TESTS

MINS: / NICKEL ALLOYS/ REFLECTANCE/ SHAPE MEMORY ALLOYS/ SOLID-SOLID INTERFACES

ABA: G.R.

ABS: A problem of considerable interest is related to the nondestructive determination of the compressive component of stress in various kinds of interference fasteners. The usual techniques employed for stress measurements are not suited for the considered case. The present paper is concerned with results which were obtained in a study of Nitinol couplers by means of a procedure utilizing ultrasonic reflectivity and suitable interpretive concepts. Nitinol, a nickel-titanium alloy, is a shape memory material which undergoes a rather special type of martensitic transformation. The Nitinol fastener is a short, thick-walled hollow cylinder. Attention is given to aspects of sample preparation and stress characterization, ultrasonic measurements, and experimental

results and interpretation.

....

84A42759 ISSUE 21 PAGE 3019 CATEGORY 26 83/00/00 12 PAGES UNCLASSIFIED DOCUMENT

UTTL: The use of shape memory effect alloys as an engineering material

AUTH: A/BENSON, R. W.; B/FLOT, R. F.; C/SANDBERG, C. L. PAA: C/(Raychem Corp., Menlo Park, CA)

CIO: UNITED STATES; IN: National Technical Conference, 15th, Cincinnati, OH, October 4-6, 1983, Proceedings (A84-42726 21-23). Azusa, CA, Society for the Advancement of Material and Process Engineering, 1983, p. 403-414.

MAJS: / *NICKEL ALLOYS/ *NITINOL ALLOYS/ *PHASE TRANSFORMATIONS/ *SHAPE MEMORY ALLOYS/ *TITANIUM ALLOYS

MINS: / ACTUATORS/ BODY CENTERED CUBIC LATTICES/ ELECTRIC CONNECTORS/ PIPES (TUBES)/ UTILIZATION

ABA: Author

ABS: The unique shape memory properties of nickel-titanium make it useful as an engineering material in many areas. Nitinol, as it is usually referred to, was discovered in the early 1960s. Shape memory effect alloys for commercial use are being developed in the following product areas: (1) pipe and tube joining systems, (2) electrical connectors, and (3) electromechanical actuators. This paper describes the metallurgical phenomenon of the martensitic to austenitic structural change and then concentrates on the practical application of this phenomenon in the aforementioned product areas.

....

82N72580# CATEGORY 44 RPT#: AD-A108973 NSWC/MP-79-441 CNT#: DOE-ET-78-I-05-5919 DOE-AI05-78-CR-05919 78/09/27 269 PAGES UNCLASSIFIED DOCUMENT

UTTL: Proceedings of the NITINOL Heat Engine Conference

TLSP: Final Report

AUTH: A/GOLDSTEIN, D. M.; B/MCNAMARA, L. J. PAT: A/ed.; B/ed.

CORP: Naval Surface Weapons Center, Silver Spring, Md. AVAIL.NTIS

CIO: UNITED STATES; Presented at Silver Spring, Maryland, 26-27 Sep. 1978

MAJS: / *ENGINE DESIGN/ *ENGINE TESTS/ *NITINOL ALLOYS/ *SHAPE MEMORY ALLOYS/ * THERMODYNAMICS

MINS: / ENERGY CONVERSION/ POWDER METALLURGY/ SYSTEM EFFECTIVENESS/ TITANIUM ALLOYS/ X RAY DIFFRACTION

....

82N19033# ISSUE 9 PAGE 1297 CATEGORY 74 RPT#: AD-A108278 NSWC/TR-81-129 NAVSEA-S562-78 81/07/01 71 PAGES UNCLASSIFIED DOCUMENT

UTTL: NITINOL interconnect device for optical fiber waveguides

TLSP: Final Report

AUTH: A/GOLDSTEIN, D.; B/TYDINGS, J.

CORP: Naval Surface Weapons Center, Silver Spring, Md. AVAIL.NTIS

SAP: HC A04/MF A01

CIO: UNITED STATES

MAJS: / *CONNECTORS/ *FIBER OPTICS/ *NITINOL ALLOYS/ *OPTICAL WAVEGUIDES

MINS: / BUNDLES/ FABRICATION/ OPTICAL COMMUNICATION/ PIPES (TUBES)/ POWDER METALLURGY

ABA: Author (GRA)

ABS: Two different interconnect devices for optical fibers have been developed. Each uses the shape memory effect alloy 'NITINOL'. The simpler of the two is of tubular design and accommodates fibers as small as 200 micron diameter. The more complex multi-component design accommodates 125 micron diameter fibers. The complex design is simpler to use, easier to manufacture and lower in cost. It permits less than 1 db loss and is re-matable. A description of NITINOL manufacture is given.

....

80X73875 CATEGORY 26 RPT#: IR-851-2(1) CNT#: F33615-72-C-1190 72/08/31 64 PAGES UNCLASSIFIED DOCUMENT US GOV AGENCIES

UTTL: Fabrication techniques for rivet fasteners utilizating 55-nitinol TLSP: Interim Report, 1 Jun. - 31 Aug. 1972

AUTH: A/SCHWENK, W.

CORP: Grumman Aerospace Corp., Bethpage, N.Y. CSS: (Fabrication Branch.)

CIO: UNITED STATES

MAJS: / *AIRCRAFT STRUCTURES/ *FASTENERS/ *NITINOL ALLOYS/ *STRUCTURAL RELIABILITY

MINS: / FATIGUE TESTS/ FORMING TECHNIQUES/ HEAT TREATMENT/ MICROSTRUCTURE/ TRANSITION TEMPERATURE

....

No: S4.1 **Title:** Independent Weapon Destruct

Operations Requirement:

Provide ground-based anti-missile-type battery of circa 1995 weapon systems to provide near-range vehicle destruct. Eliminate extensive non-productive manhours for "area clear" during range safety ordnance installation. Minimize "safety army" and procedures that accommodate contemporary systems and methods.

Rationale:

Elimination of vehicle range safety ordnance and associated non-productive manhours and operational cost is highly desirable. Consider current range safety regulations negotiable.

See S4 for quantified data.

Sample Concept:

Delete the extensive vehicle/ground remote destruct system. If an unmanned vehicle goes awry during the first minutes of launch (or close to launch site) use ground based anti-missile weapons to provide range destruct. Use beacon on-board space vehicle to assist in identification and guidance.

See also, S4.

Technology Requirement:

None. Use military antimissile system of circa 1995 vintage .

Technology References:

N/A

No.: S4.2 **Title:** Laser Ignition

Operational Requirement:

Eliminate pyrotechnic type ordnance where possible; At least, provide system with less stringent safety requirements.

Rationale:

There are four types of ordnance devices currently used on STS: ignition, release, separation, and range safety. The special handling safety, area clear, and training requirements make this a major cost area in ground processing.

See S4 for quantified data.

Sample Concept:

A laser ordnance initiation system provides the capability to reliably control ordnance functions on launch vehicles. Examples of ordnance events which can be controlled by a laser system include motor ignition, stage separation, thermal battery activation, shroud removal, destruct, etc. There are significant improvements in safety, weight, cost, and processing time offered by laser systems over conventional electro-explosive ordnance initiation. The additional capability for safe, positive on-board system interrogation and test can provide an assurance of launch vehicle readiness never before attained with traditional ordnance systems.

See also, S4.

Technology Requirement:

Continued development of laser-initiated ordnance for specific ALS-related requirements.

Technology References:

Vendor data (Ensign-Bickford Co., Aerospace Division, Simsbury, Connecticut).

No: S4.3 **Title:** Non-pyrotechnic Separation (Acceleration/Clevis Separation)

Operations Requirement:

Simplify vehicle separation design and related ground processing.

Rationale:

Contemporary stage separation hardware and ground processing are complex, hazardous, and manpower intensive.

Test and checkout of electrical systems for ignition of pyrotechnic devices is lengthy and wasteful of manpower during repetitive "area clear" operations. STS 51-L preps for mating required a total clock time of 72 hours directly related to separation hardware and pyrotechnics installation and test.

See S4 for quantified data.

Sample Concept:

The concept of individual vehicle transit to pad and individual erection, suggests the geometric possibility of a vehicle "back-to-back" or parallel mating and a separation system requiring no moving parts or pyrotechnics. Examination of the following process is suggested:

(1) Design booster and orbiter propulsion/ acceleration mechanics such that the booster acceleration component exceeds that of the orbiter i.e., the booster wants to outclimb or run ahead of the orbiter.

(2) Erect the booster first. Subsequent rotation of the orbiter to vertical about its landing gear (over the flame pond, onto a thrust butt) may allow automatic attachment of the orbiter to the booster by means of a male/female clevis (or pintle and gudgeon arrangement) having no moving parts or pyrotechnics. The orbiter is effectively impaled on the booster.

(3) When the booster propellants are expended, aerodynamic drag provides stage separation. Propulsion for a second parallel stage, if used, could be terminated by stage-autonomous acceleration-sensing avionics.

See also, S4.

Technology Requirement:

Detailed examination of aerodynamics and related shock-wave interactions would be necessary to assure validity of concept.

Either a twin-hull booster, an exterior payload bay, parallel mating (or other alternative) will be required to eliminate structural interference of the vehicles during erection of the orbiter.

Technology References:

This document.

No: P1 **Title:** Simplified Robust Propulsion System

Operations Requirement:

Simplified, integrated, robust propulsion system that uses the same oxid fuel, and integrates the essential elements of:

- Main propulsion
- Orbital maneuver/de-orbit
- Attitude/rendezvous control

Rationale:

Current propulsion systems started with an engine design and then the built around it.

There is a necessity to simplify and integrate all propulsion sys radically minimize the supporting operations and maintenance.

Sample Concept:

Fully-throttleable engines/multiphase (see P1.1)

Soft engine start (see P1.2)

TVC by delta thrust and/or RCS/or aero (see P1.3)

One oxidizer/ one fuel (see P1.4)

Eliminate separate OMS and RCS (see P2)

Eliminate high-maintenance turbopumps (see P3)

No hydraulics (see P4)

Technology Requirement:

(See P1.1 through P8)

Technology References:

NASA/RECON:

87A32466,	87A18475,	87A11334,	87A10698,	86X10270,	86N70079,
86A42731,	86A42620,	85X77367,	85X74308,	85X70592,	85N25389,
85N29965,	85N26862,	85A39670,	85A13519,	84X78616,	84X78036,
84X72894,	84N32430,	84N71351,	84K11473,	84A38153,	84A35137,
83A29534,	83A28693,	82X73602,	82A44488,	79X75706,	78A11082,
74N71316,	74N70964,	74A12920,	74A11559,	73N12847,	73N12840

PAGE 194 INTENTIONALLY BLANK

87A32466 ISSUE 13 PAGE 1924 CATEGORY 15 86/00/00 6 PAGES UNCLASSIFIED DOCUMENT COPYRIGHT

UTTL: The status of H-II rocket development program

AUTH: A/ETO, TAKAO; B/SHIBATO, YOJI

PAA: B/(National Space Development Agency of Japan, Tokyo)

CIO: JAPAN

IN: International Symposium on Space Technology and Science, 15th, Tokyo, Japan, May 19-23, 1986, Proceedings. Volume 2 (A87-32276 13-12). Tokyo, AGNE Publishing, Inc., 1986, p. 1403-1408.

MAJS: / *JAPANESE SPACE PROGRAM/ *LAUNCH VEHICLES/ *RESEARCH AND DEVELOPMENT

MINS: / AVIONICS/ BOOSTER ROCKET ENGINES/ ROCKET ENGINES/ SCHEDULING

ABA: I.F.

ABS: The design and development program of the H-II rocket are described. The launch vehicle consists of cryogenic first and second stages of 4 m in diameter and a pair of solid rocket boosters, and has a payload capability of 2 tons. The cryogenic first stage is powered by the LE-7 engine which produces 910 K thrust at sea level and 1180 kN thrust in vacuum and has a total burning duration of 316 seconds; the designs of the engine and stage are examined. The second stage propulsion system uses an LE-5 engine with a thrust of 103 kN at a chamber pressue of 3.7 MPa. Consideration is given to the payload fairing, solid rocket booster, and avionics system for the H-II rocket. Diagrams of the H-II and its components are provided.

....

87A18475 ISSUE 6 PAGE 734 CATEGORY 15 RPT#: AAS PAPER 85-642 PA86/00/00 14 PAGES UNCLASSIFIED DOCUMENT

UTTL: H-II launch vehicle

AUTH: A/TAKATSUKA, H.; B/ETOH, T. PAA: B/(National Space Development Agency of Japan, Tokyo)

CIO: JAPAN; IN: Space exploitation and utilization; Proceedings of the Symposium, Honolulu, HI, December 15-19, 1985 (A87-18451 06-12). San Diego, CA, Univelt, Inc., 1986, p. 351-364.

MAJS: / *JAPANESE SPACE PROGRAM/ *LAUNCH VEHICLES/ *PROPULSION SYSTEM CONFIGURATIONS/ *RESEARCH AND DEVELOPMENT

MINS: /AVIONICS/ BOOSTER ROCKETS/ COST EFFECTIVENESS/ PAYLOADS/ SOLID PROPELLANT ROCKET ENGINES/ SPACE COMMERCIALIZATION

ABA: D.H.

ABS: Overall features of the configuration, capability, and development program of the H-II rocket are discussed. The H-II rocket is Japan's new expendable launch vehicle for the 1990s with a capability of launching a 2-ton payload to GEO. Lift-off mass will be 255 tons. Propellants for the first stage will be LOX and LH2, for the second stage a composite, and the third stage again LOX and LH2.

....

87A11334 ISSUE 1 PAGE 9 CATEGORY 16 85/00/00 360 PAGES In RUSSIAN UNCLASSIFIED DOCUMENT

UTTL: Fundamentals of flight vehicle design (transport systems)- Russian book

AUTH: A/MISHIN, V. P.; B/BEZVERBYI, V. K.; C/PANKRATOV, B. M.; D/SHCHEVEROV, D. N.

CIO: U.S.S.R.; Moscow, Izdatel'stvo Mashinostroenie, 1985, 360 p. In Russian.

MAJS: / *BALLISTIC MISSILES/ *BOOSTER ROCKETS/ *REUSABLE SPACECRAFT/ *SPACECRAFT DESIGN

MINS: / AUTOMATION/ DESIGN ANALYSIS/ GROUND SUPPORT EQUIPMENT/ LIQUID PROPELLANT ROCKET ENGINES/ RELIABILITY ENGINEERING/ ROCKET ENGINE DESIGN/ SPACE SHUTTLES/ SPACECRAFT CONFIGURATIONS/ SPACECRAFT LANDING

ABA: V.L.

ABS: Various aspects of the design of flight vehicles, classified under ballistic rockets and carrier rockets, are examined in the light of recent work in this field. Topics discussed include design configurations of liquid-propellant rockets, determination of the principal design parameters of ballistic rockets and carrier rockets from specified flight performance data, and the design of reusable flight vehicles. The discussion also covers an experimental verification program for ensuring the reliability of flight vehicles and the organization, planning, and automation of the design and production of flight vehicles.

....

87A10698 ISSUE 1 PAGE 51 CATEGORY 38 RPT#: AD-A170037 CNT#: DAAG29-84-K-0173 86/00/00 7 PAGES UNCLASSIFIED DOCUMENT COPYRIGHT

UTTL: Contrast mechanisms in the thermoacoustic microscope

AUTH: A/FAVRO, L. D.; B/KUO, P. K.; C/THOMAS, R. L.

PAA: C/(Wayne State University, Detroit, MI)

CIO: UNITED STATES

IN: Review of progress in quantitative nondestructive evaluation. Volume 5A - Proceedings of the Twelfth Annual Review, Williamsburg, VA, June 23-28, 1985 (A87-10676 01-38). New York, Plenum Press, 1986, p. 439-445.

MAJS: / *ACOUSTIC MICROSCOPES/ *IMAGE CONTRAST/ *IMAGING TECHNIQUES/ *NONDESTRUCTIVE TESTS/ *THERMOGRAPHY

MINS: / ACOUSTIC SCATTERING/ PARTICLE MOTION/ THERMAL RADIATION

ABA: T.K.

ABS: The mechanisms of image formation in thermoacoustic microscopy (TAM) are investigated theoretically, summarizing and applying the analytical results of Favro et al. (1984 and 1985). In TAM, a 1-10,000-kHz-modulated particle beam heats the sample specimen on or near its surface, producing sonic-to-ultrasonic acoustic waves which are detected by a piezoelectric transducer attached to a different part of the specimen; the acoustic signals produced by scanning the beam over the specimen surface are interpreted as an image and used to locate discontinuities. Four processes producing image contrast are identified: (1) pure acoustic scattering, (2) thermal/acoustic mode conversion at the surface followed by acoustic scattering, (3) pure thermal scattering followed by surface mode conversion, and (4) mode conversion at the scattering defect itself. The relative efficiencies of these processes are evaluated, and it is shown that process 3, the mechanism commonly assumed in interpreting TAM images, is dominated by processes 1 and 4 in most cases. TAM operation near the near-field (Fresnel) or far-field (Fraunhofer) limits is examined, and the results of recent experiments are discussed in the light of the present results and the extreme-near-field theory of Inglehart et al. (1983).

....

86X10270* ISSUE 8 CATEGORY 1 RPT#: NASA-SP-7058 NAS 1.21:7058 86/06/00 324 PAGES UNCLASSIFIED DOCUMENT US GOV AGENCIES AND CONTRACTORS

UTTL: European aeronautics and astronautics: A bibliography with indexes

CORP: National Aeronautics and Space Administration, Washington, D.C.

MFC: 00

CIO: UNITED STATES

MAJS: / *AERONAUTICAL ENGINEERING/ *AEROSPACE ENGINEERING/ *ASTRONAUTICS/ *BIBLIOGRAPHIES

MINS: / AEROSPACE MEDICINE/ AIRCRAFT CONSTRUCTION MATERIALS/ AIRCRAFT DESIGN/ AIRCRAFT ENGINES/ AVIONICS/ EUROPE/ SPACE EXPLORATION/ SPACECRAFT CONSTRUCTION MATERIALS/ SPACECRAFT DESIGN/ SPACECRAFT PROPULSION/ TELECOMMUNICATION

ABA: M.G.

ABS: This bibliography contains 1433 annotated references to reports and journal articles of European intellectual origin entered into the NASA scientific and technical information database during 1985. Representative subject areas include: aerodynamics, aircraft design and instrumentation, aerospace materials, communications, spacecraft design and related engineering, natural space sciences, and aerospace medicine.

....

86N70079* CATEGORY 20 RPT#: NASA-CR-178601 NAS 1.26:178601 CDR-85-221 BMTPN-7 CNT#: NAS8-35771 85/10/10 81 PAGES UNCLASSIFIED DOCUMENT

UTTL: High area ratio nozzle concepts investigation

TLSP: Bimonthly Technical Progress Narrative

AUTH: A/BAILY, R. D.

CORP: Rockwell International Corp., Canoga Park, Calif. AVAIL.NTIS

CIO: UNITED STATES

MAJS: / *HYDROGEN OXYGEN ENGINES/ *MANNED SPACE FLIGHT/ *NOZZLE DESIGN/ *NOZZLE EFFICIENCY/ *NOZZLE GEOMETRY/ *ORBIT TRANSFER VEHICLES/ *PROPULSION/ *ROCKET NOZZLES

MINS: / COMBUSTION CHAMBERS/ HIGH PRESSURE/ LIFE (DURABILITY)/ PERFORMANCE TESTS / RELIABILITY

....

86A42731# ISSUE 20 PAGE 2951 CATEGORY 28 RPT#: AIAA PAPER 86-1587 86/06/00 5 PAGES UNCLASSIFIED DOCUMENT

UTTL: Propellant performance of Mars-produced carbon monoxide

AUTH: A/CLAPP, W. M.

PAA: A/(USAF, Foreign Technology Div., Wright-Patterson AFB, OH)

CIO: UNITED STATES AIAA, ASME, SAE, and ASEE, Joint Propulsion Conference, 22nd, Huntsville, AL, June 16-18, 1986. 5 p.

MAJS: / *CARBON MONOXIDE/ *EXTRATERRESTRIAL RESOURCES/ *LIQUID ROCKET PROPELLANTS/ * MARS ATMOSPHERE/ *PROPELLANTS/ *SPACE MISSIONS

MINS: / DIESEL ENGINES/ FUEL CELLS/ PROPELLANT COMBUSTION/ ROCKET ENGINES/ SPACE COMMERCIALIZATION/ THERMODYNAMICS

ABA: Author

ABS: The performance of the liquid carbon monoxide (LCO) - liquid oxygen (LOX) propellant combination is modeled in detail. Calculations were performed to model three propulsion applications: rocket and internal combustion engines, and fuel cells. It was determined that rocket engines burning carbon monoxide with oxygen are capable of specific impulses in the 280-300 second range. This level of performance makes possible such missions as single stage to orbit and even single stage to hyperbolic escape. In addition, LCO may be used as a fuel in internal combustion engines. Thermodynamic cycle calculations show that such engines can achieve power densities competitive with batteries. Superior performance is possible if LCO and LOX are used to operate an electrochemical fuel cell.

....

86A42620# ISSUE 20 PAGE 3010 CATEGORY 83 RPT#: AIAA PAPER 86-1408 86/06/00 12 PAGES UNCLASSIFIED DOCUMENT COPYRIGHT

UTTL: Life cycle cost considerations for launch vehicle liquid propellant rocket engines

AUTH: A/MEISL, C. J.

PAA: A/(Rockwell International Corp., Rocketdyne Div., Canoga Park, CA)

CIO: UNITED STATES; AIAA, ASME, SAE, and ASEE, Joint Propulsion Conference, 22nd, Huntsville, AL, June 16-18, 1986. 12 p.

MAJS: / *COST EFFECTIVENESS/ *LAUNCH VEHICLES/ *LIFE CYCLE COSTS/ *LIQUID PROPELLANT ROCKET ENGINES

MINS: / ENGINE TESTS/ EXPENDABLE STAGES (SPACECRAFT)/ PRODUCTION COSTS/ RELIABILITY/ ROCKET ENGINE DESIGN/ SPACE SHUTTLE MAIN ENGINE/ SPACE SHUTTLE ORBITERS

ABA: Author

ABS: This paper discusses the engine cost contribution to the life cycle cost (LCC) of launch vehicles, and what cost differences exist between engines designed for expendable and for reusable vehicles. The cost drivers in the engine development and production phases, and during vehicle flight operation, are delineated. Analysis of historical cost data and parametric cost modeling were used as a basis for the cost observations. Several measures for potential engine cost reduction are discussed. These include the early use of a test bed, and the selection of the SSME reliability and test approach for development costs; the introduction of multi-year buys for expendable engines to capitalize on the cost advantages of high production quantities and rates through low-cost fabrication methods with automation; and the decrease in operation and support costs for reusable engines due to the use of long life and high Mean Time Between Replacement (MTBR) components, and by extensively employing condition monitoring and diagnostic instrumentation.

....

85X77367# CATEGORY 20 85/09/16 4 PAGES UNCLASSIFIED DOCUMENT US GOV AGENCIES

UTTL: Dynamics of liquid-fuel rocket engine units and supply systems

AUTH: A/PRISNYAKOV, V. F.

CORP: Joint Publications Research Service, Arlington, Va. In its USSR Rept.: Eng. and Equipment (JPRS-UEQ-85-010-L) p 1-4 (SEE X85-77366 23-31)

CIO: U.S.S.R. Transl. into ENGLISH from the book ""Dinamika Zhidkostnykh Raketnykh Dvigatelnykh Ustanovok i Sistem Pitaniya'' Moscow, Mashinostroyeniye, 1983 p 2-5

MAJS: / *AERONAUTICAL ENGINEERING/ *AIRCRAFT FUEL SYSTEMS/ *DYNAMIC CHARACTERISTICS / *LIQUID PROPELLANT ROCKET ENGINES/ *STEADY STATE

MINS: / AUTOMATIC CONTROL/ COMBUSTION CHAMBERS/ FUEL PUMPS/ GAS GENERATORS/ TURBINE PUMPS

....

85X74308# CATEGORY 20 RPT#: AD-B090116L RI/RD84-146 RADC-TR-84-212 CNT#: F30602-80-C-0146 84/11/00 72 PAGES UNCLASSIFIED DOCUMENT US GOV AGENCIES AND CONTRACTORS

UTTL: Liquid rocket engine schematic model

TLSP: Final Report, Feb. 1983 - Apr. 1984

AUTH: A/IWANICKI, L.; B/TANIGUCHI, M.; C/JONES, R. D.

CORP: Rockwell International Corp., Canoga Park, Calif. CSS: (Rocketdyne Div.)

CIO: UNITED STATES

MAJS: / *COMPUTERIZED SIMULATION/ *LIQUID PROPELLANT ROCKET ENGINES/ *MATHEMATICAL MODELS/ *PROPULSION/ *STEADY STATE/ *TWO PHASE FLOW

MINS: /ATTITUDE CONTROL/ COLD GAS/ LIQUID ROCKET PROPELLANTS/ MONOPROPELLANTS/ PUMPS/ SPACE FLIGHT/ SURGES/ TRAJECTORIES

....

85X70592# CATEGORY 20 RPT#: AD-B085696L HAC-REF-E007- VOL-5-PT-20 AFWAL-TR-83-2025-VOL-5-PT-2

CNT#: F33615-78-C-2600 83/12/00 589 PAGES UNCLASSIFIED DOCUMENT US GOV AGENCIES

UTTL: Ducted rocket propulsion technology validation. Volume 5: Flight test vehicle analysis and development. Part 2: Flight controls system

TLSP: Final Report, Sep. 1978 - Dec. 1983

AUTH: A/DEKKER, J. H.; B/OLDEN, C. D.; C/PHILLIPS, B. R.

CORP: Hughes Aircraft Co., Canoga Park, Calif. CSS: (Missile Systems Group.)

CIO: UNITED STATES; Wright-Patterson AFB, Ohio. AFWAL

MAJS: / *ACTUATORS/ *AIR TO AIR MISSILES/ *AUTOMATIC PILOTS/ *COMPUTER PROGRAMS/ * DUCTED ROCKET ENGINES/ *FLIGHT TEST VEHICLES/ *MISSILE COMPONENTS/ *POWER CONDITIONING/ *SYSTEMS ANALYSIS

MINS: / BOOSTER ROCKET ENGINES/ ELECTRIC BATTERIES/ ELECTROMECHANICAL DEVICES/ ELECTRONIC EQUIPMENT/ FLIGHT CONTROL/ INERTIAL PLATFORMS/ RAMJET ENGINES

....

85N29965*# ISSUE 19 PAGE 3220 CATEGORY 7 RPT#: NASA-CR-174953 NAS 1.26:174953 PWA-FR-18323-2 REPT-8881-933004 CNT#: NAS3-22902 85/07/01 113 PAGES UNCLASSIFIED DOCUMENT

UTTL: Convoluted nozzle design for the RL10 derivative 2B engine TLSP: Final Report

CORP: Pratt and Whitney Aircraft, West Palm Beach, Fla.; Textron Bell Aerospace Co., Buffalo, N. Y.

CSS: (Government Products Div.) AVAIL.NTIS

SAP: HC A06/MF A01

CIO: UNITED STATES; Prepared in cooperation with Textron Bell Aerospace Co., Buffalo, N.Y.

MAJS: / *CONVOLUTION INTEGRALS/ *NOZZLE DESIGN/ *ORBIT TRANSFER VEHICLES/ * REFRACTORY MATERIALS/ *RL-10 ENGINES

MINS: / LIQUID PROPELLANT ROCKET ENGINES/ ROCKET ENGINES/ STRUCTURAL ANALYSIS/ THERMAL ANALYSIS

ABA: E.A.K.

ABS: The convoluted nozzle is a conventional refractory metal nozzle extension that is formed with a portion of the nozzle convoluted to show the extendible nozzle within the length of the rocket engine. The convoluted nozzle (CN) was deployed by a system of four gas driven actuators. For spacecraft applications the optimum CN may be self-deployed by internal pressure retained, during deployment, by a jettisonable exit closure. The convoluted nozzle is included in a study of extendible nozzles for the RL10 Engine Derivative 2B for use in an early orbit transfer vehicle (OTV). Four extendible nozzle configurations for the RL10-2B engine were evaluated. Three configurations of the two position nozzle were studied including a hydrogen dump cooled metal nozzle and radiation cooled nozzles of refractory metal and carbon/carbon composite construction respectively.

....

85N26862*# ISSUE 16 PAGE 2733 CATEGORY 20 RPT#: NASA-CP-2372 NAS 1.55:2372 85/04/00 753 PAGES UNCLASSIFIED DOCUMENT

UTTL: Advanced High Pressure O2/H2 Technology

AUTH: A/MOREA, S. F.; B/WU, S. T.

PAA: B/(Alabama Univ., Huntsville) PAT: A/ed.; B/ed.

CORP: National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala. AVAIL.NTIS

SAP: HC A99/MF E03; SOD HC

CIO: UNITED STATES; Washington Conf. held in Huntsville, Ala., 27-29 Jun. 1984

MAJS: / *COMBUSTION CHAMBERS/ *CONFERENCES/ *ENGINE MONITORING INSTRUMENTS/ *ENGINE PARTS/ *HYDROGEN OXYGEN ENGINES/ *SPACE SHUTTLE MAIN ENGINE/ *TURBINE BLADES / *TURBINE PUMPS

MINS: / BEARINGS/ CERAMICS/ COMBUSTION/ DYNAMIC STRUCTURAL ANALYSIS/ FRACTURE MECHANICS/ HEAT RESISTANT ALLOYS/ MANUFACTURING/ METAL MATRIX COMPOSITES/ ROTORS/ THERMAL CONTROL COATINGS

ANN: Activities in the development of advanced high pressure oxygen-hydrogen stag combustion rocket engines are reported. Particular emphasis is given to the Space Shuttle main engine. The areas of engine technology discussed include fracture and fatigue in engine components, manufacturing and producibility engineering, materials, bearing technology, structure dynamics, fluid dynamics, and instrumentation technology. For individual titles see N85-26863 through N85-2691.

....

85N25389# ISSUE 15 PAGE 2495 CATEGORY 20 RPT#: AD-A151368 AFRPL-TR-84-101 CNT#: AF PROJ. 9991 84/12/00 89 PAGES UNCLASSIFIED DOCUMENT

UTTL: AFRPL (Air Force Rocket Propulsion Laboratory) technical objective document FY 85 TLSP: Technical Report, 1 Oct. 1985 - 30 Sep. 1986

AUTH: A/WISWELL, R. L.

CORP: Air Force Rocket Propulsion Lab., Edwards AFB, Calif. AVAIL.NTIS

SAP: HC A05/MF A01

CIO: UNITED STATES

MAJS: / *LABORATORIES/ *LIQUID PROPELLANT ROCKET ENGINS/ *PROPULSION/ *RESEARCH/ * SOLID PROPELLANT ROCKET ENGINES

MIN: / LAUNCH VEHICLES/ MISSILES/ PLUMES/ ROCKET EXHAUST/ SOLID PROPELLANT COMBUSTION/ SPACECRAFT PROPULSION

ABA: GRA

ABS: This report is a summary of technical objectives and approaches for research, exploratory development, and advanced development efforts being pursued, and to be pursued, at the Air Force Rocket Propulsion Lab. between FY 84-90.

....

85A39670# ISSUE 18 PAGE 2636 CATEGORY 20 RPT#: AIAA PAPER 85-1231 85/07/00 9 PAGES UNCLASSIFIED DOCUMENT

UTTL: Propellant management in toroidal tanks

AUTH: A/DOMINICK, S. M.; B/TEGART, J. R. PAA: B/(Martin Marietta Aerospace, Propulsion Section, Denver, CO)

CIO: UNITED STATES; AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference, 21st, Monterey, CA, July 8-10, 1985. 9 p.

MAJS: / *ORBIT TRANSFER VEHICLES/ *PROPELLANT TANKS/ *PROPULSION SYSTEM PERFORMANCE / *TOROIDAL SHELLS

MINS: / BAFFLES/ DROP TOWERS/ FLUID DYNAMICS/LIQUID ROCKET PROPELLANTS/ TEST FACILITIES/ WEIGHTLESSNESS

ABA: M.S.K.

AS: The results of a propellant management study applied to a cryogenic toroidal tank OTV are reported. A toroidal geometry for containment of the oxidizer offers a more efficient geometry of SIS bay storage, and therefore more payload space. Toroidal tanks present problems in the control of the position of the liquid and efficient draining. Tests have been performed with total capillary communication, which would assess the delivery of only gas-free fuel to the thruster, trap devices to hold propellant available for engine start, and propulsive settling configurations to move fuel to a position over the tank outlet before each firing. Test results from bare, four and eight-baffled toroidal tanks are discussed.

....

85A13519# ISSUE 3 PAGE 257 CATEGORY 5 RPT#: AIAA PAPER 84-2414 84/10/00 6 PAGES UNCLASSIFIED DOCUMENT

UTTL: Transatmospheric vehicles - A challenge for the next century

AUTH: A/TREMAINE, S. A.; B/ARNETT, J. B. PAA: A/(USAF, Aeronautical Systems Div, Wright-Patterson AFB, OH)

CIO: UNITED STATES; AIAA, AHS, ASEE, Aircraft Design Systems and Operations Meeting, San Diego, CA, Oct. 31-Nov.

2, 1984. 6 p.

MAJS: / *AEROSPACEPLANES/ *MILITARY AIRCRAFT/ *SPACE TRANSPORTATION/ *TECHNOLOGICAL FORECASTING/ *TRANSATMOSPHERIC VEHICLES

MINS: / ARTIFICIAL INTELLIGENCE/ FLIGHT VEHICLES/ MATERIALS/ PROPULSION/ SUPPORT SYSTEMS

ABA: O.C.

ABS: The U.S. Air Force Systems Command's Aeronautical Systems Division has begun to investigate the Transatmospheric Vehicle (TAV) concept, which is seen as a global range military aircraft, operating from conventional airfields, whose hypersonic speed cruise regime would be at the upper reaches of the atmosphere. Attention is given to the difficulties inherent in the TAV design's reconciliation of aerothermodynamically highly stressed outer skin surfaces and cryogenic fuel tankage. Both airbreathing and rocket propulsion concepts are under consideration, as are exotic fuels and oxidizers possessing higher energy densities. One such fuel, metastable helium, would yield six times the propulsion efficiency of current cryogenic fuels.

....

84X78616# CATEGORY 20 RPT#: AD-C034852 HAC-E0070-VOL-4-PT-2 AFWAL-TR-83-2025- VOL-4-PT-2 CNT#: F33615-78-C-2600 83/12/00 780 PAGES CONFIDENTIAL DOCUMENT US GOV AGENCIES

UTTL: Ducted rocket propulsion technology validation. Volume 4: Propulsion system inlet, part 2 (U)

TLSP: Final Report, Sep. 1978 - Dec. 1983

AUTH: A/DEKKER, J. H.; B/PHILLIPS, B. R.

CORP: Hughes Aircraft Co., Canoga Park, Calif. CSS: (Missile Systems Group.)

CIO: UNITED STATES

MAJS: / *BOOSTER ROCKET ENGINES/ *DUCTED ROCKET ENGINES/ *PROPULSION/ *RAMJET ENGINES

MINS: / DRAG/ DUCTS/ ENGINE INLETS/ GAS GENERATORS/ INTAKE SYSTEMS/ MISSILE COMPONENTS/ PROVING/ SUBSONIC FLOW/ TECHNOLOGIES

....

84X78036 CATEGORY 28 CNT#: F04611-82-C-002 84/02/00 12 PAGES UNCLASSIFIED DOCUMENT US GOV AGENCIES

UTTL: Propellant handling concepts for future launch-on-demand vehicles

AUTH: A/REED, L. R; B/ROSE, . J.

CORP: Martin Marietta Aerospace, Denver, Colo.

SAP: Limited by ITAR; In APL The 1984 JANNAF Propulsion Meeting, Vol. 4 p 145-156 (SEE X8478022 21-20)

CIO: UNITED STATES

MAJS: / *CRYOGENIC ROCKET PROPELLANTS/ *PROPELLANT STORAGE/ *PROPELLANT TRANSFER/ * REUSABLE SPACECRAFT/ *SPACECRAFT MAINTENANCE/ *SPACECRAFT SURVIVABILITY

MINS: /COST ANALYSIS/ CRYOGENIC FLUID STORAGE/ GROUND SUPPORT EQUIPMENT/ GROUND SUPPORT SYSTEMS/ LAUNCH VEHICLE CONFIGURATIONS

....

84X72894 CATEGORY 20 RPT#: AD-B995141 CPIA-LS83-36 CNT#: N00024-83-C-5301 83/11/00 57 PAGES UNCLASSIFIED DOCUMENT US GOV AGENCIES

UTTL: Extendible exit cones. A bibliography

CORP: Johns Hopkins Univ., Silver Spring, Md. CSS: (Chemical Propulsion Information Agency.)

SAP: Limited by ITAR

CIO: UNITED STATES

MAJS: / *BIBLIOGRAPHIES/ *CHEMICAL PROPULSION/ *CONICAL BODIES/ *CONICAL NOZZLES/ * NOZZLE GEOMETRY

MINS: / CARBON-CARBON COMPOSITES/ COMPUTER PROGRAMS/ COST ANALYSIS/ ORBIT TRANSFER VEHICLES/ PLUMES/ ROCKET ENGINE CASES/ SPACE SHUTTLES/ STRESS ANALYSIS

....

84N71351# CATEGORY 28 RPT#: AD-A132153 AD-E850405 PUAMS-1321 76/12/00 114 PAGES UNCLASSIFIED DOCUMENT

UTTL: Propellant combustion and propulsion: Nine year index and abstracts of publications by Princeton University, 1968 -1976

CORP: Princeton Univ., N. J.

CSS: (Dept. of Aerospace and Mechanical Sciences.) AVAIL.NTIS

CIO: UNITED STATES

MAJS: / *ABSTRACTS/ *PROPELLANT COMBUSTION/ *PROPULSION/ *SOLID PROPELLANT ROCKET ENGINES

MINS: / COMBUSTION STABILITY/ COMPOSITE PROPELLANTS/ CONVECTION/ DOUBLE BASE PROPELLANTS/ DROPS (LIQUIDS)/ EROSION/ EXTINGUISHING/ FLAME PROPAGATION/ LIQUID FUELS/ METALS/ POROSITY/ RADIANT HEATING/ SOLID PROPELLANT IGNITION / STEADY STATE/ SURGES

....

84N32430# ISSUE 22 PAGE 3543 CATEGORY 20 RPT#: AD-A143179 WSRL-0332-TR 83/09/00 26 PAGES UNCLASSIFIED DOCUMENT

UTTL: Static thrust augmentation of rocket motors by air entrainment

AUTH: A/IRVINE, R. D.

CORP: Weapons Systems Research Lab., Adelaide (Australia). AVAIL.NTIS

SAP: HC A03/MF A01

CIO: AUSTRALIA

MAJS: / *AIR/ *CONICAL NOZZLES/ *ENTRAINMENT/ *STATIC THRUST/ *THRUST AUGMENTATION

MINS: / DUCTS/ DYNAMIC PRESSURE/ NOZZLE EFFICIENCY/ PRESSURE RATIO/ PROPULSION/ ROCKET ENGINES/ ROCKET EXHAUST/ ROCKET NOZZLES

ABA: GRA

ABS: The effect of duct geometry and primary jet characteristics on the level of thrust augmentation of conventional rocket motor jets, with conical nozzles exhausting into a stationary atmosphere, has been investigated. For a range of straight, cylindrical ducts with bell-mouth inlets, it is found that the duct thrust is primarily a function of duct length and primary thrust. Chamber pressure and nozzle conditions have little effect other than their effect on primary thrust.

....

84K11473 (Sup-010) CNT#: NAG3-571 DUN#: 071124788

CIO#: 1029370 505-40-5B 505-62-01 National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio. A/OAST John Carroll Univ., Cleveland, Ohio.

UTTL: Digital optical sensors using wavelength division multiplexing and interferometer techniques UNCLASSIFIED OCTOBER 1, 1984 / FEBRUARY 14, 1988

TM: · A/BALMEICK, R. J. A/2034

PI: B/FRITSCH, K. REPORTS EXPECTED

MAJS: / *COMBUSTION CONTROL/ *OPTICAL MEASURING INSTRUMENTS/ *PROPULSION/ *PROPULSION SYSTEM PERFORMANCE/ *PROPULSIVE EFFICIENCY

....

84A38153* ISSUE 18 PAGE 2594 CATEGORY 20 82/00/00 10 PAGES UNCLASSIFIED DOCUMENT COPYRIGHT

UTTL: Technology status report on hydrocarbon-fueled engines for space transportation systems

AUTH: A/LA BOTZ, R. J.

PAA: A/(Aerojet Liquid Rocket Co., Sacramento, CA)

CORP: Aerojet Liquid Rocket Co., Sacramento, Calif.

CIO: UNITED STATES

IN: International Symposium on Space Technology and Science, 13th, Tokyo, Japan, June 28-July 3, 1982, Proceedings (A84-38127 18-12). Tokyo, AGNE Publishing, Inc., 1982, p. 211-220. NASA-supported research.

MAJS: / *BOOSTER ROCKET ENGINES/ *HYDROCARBON FUELS/ *SPACE TRANSPORTATION/ * SPACECRAFT PROPULSION/ *TECHNOLOGY ASSESSMENT

MINS: / HEAT TRANSFER/ LIQUID OXYGEN/ PREBURNERS/ PROPANE/ TEST FIRING

ABA: Author

ABS: Liquid oxygen/hydrocarbon (LOX/HC) fueled engines are being considered for use in future high-pressure engines for launch vehicles and as possible replacements for the orbital maneuvering system and reaction control system engines on the Space Shuttle. High performance, reusability, and low life cycle cost are required for these applications. A technology base for these engines is now being established. This paper provides a review of recent results from LOX/HC technology contracts for the National Aeronautics and Space Administration.

....

84A35137# ISSUE 16 PAGE 2290 CATEGORY 20 RPT#: AIAA PAPER 84-1223 84/06/00 9 PAGES UNCLASSIFIED DOCUMENT COPYRIGHT

UTTL: Development of LOX/LH2 engine LE-5

AUTH: A/YANAGAWA, K.; B/FUJITA, T.; C/KATSUTA, H.; D/MIYAJIMA, H. PAA: B/(National Space Development Agency of Japan, Kakuda, Miyagi, Japan); C/(National Space Development Agency of Japan, Tokyo, Japan); D/(National Aerospace Laboratory, Kakuda, Miyagi, Japan)

CIO: JAPAN AIAA, SAE, and ASME, Joint Propulsion Conference, 20th, Cincinnati, OH, June 11-13, 1984. 9 p.

MAJS: / *ENGINE DESIGN/ *ENGINE PARTS/ *GAS GENERATORS/ *HYDROGEN OXYGEN ENGINES/ * RESEARCH AND DEVELOPMENT/ *SPACECRAFT PROPULSION

MINS: / COMBUSTION CHAMBERS/ ENGINE TESTS/ INJECTORS/ LAUNCH VEHICLES/ NOZZLE DESIGN/ PERFORMANCE TESTS/ REVISIONS/ TEST STANDS

ABA: Author

ABS: The LE-5 is a second stage engine of the H-I which is a future launch vehicle in Japan. National Space Development Agency of Japan (NASDA) initiated the development of the LE-5 in 1977, and is to complete it by 1985. The design feasibility phase was completed in 1982. NASDA conducted the flight type engine tests in a simulated altitude condition from September 1982 to February 1984. Engine specific impulse reaches approximately 448 s, exceeding the designed value. The LE-5, with a unique start method, starts with high reliability because of its simple structure. The tests show the compatibility of the LE-5 with the H-I.

....

83A29534# ISSUE 12 PAGE 1708 CATEGORY 20 83/00/00 7 PAGES UNCLASSIFIED DOCUMENT

UTTL: Liquid rocket propulsion: An evaluation of our national capability - An AIAA position paper

CIO: UNKNOWN; New York, American Institute of Aeronautics and Astronautics, 1983, 7 p.

MAJS: / *LIQUID PROPELLANT ROCKET ENGINES/ *PROPULSION SYSTEM PERFORMANCE/ *ROCKET ENGINE DESIGN/ *SPACE MISSIONS/ *SPACECRAFT PROPULSION/ *TECHNOLOGY ASSESSMENT

MINS: / COST REDUCTION/ EVALUATION/ LAUNCH VEHICLES/ NASA PROGRAMS/ SPACE SHUTTLE PAYLOADS/ SPACECRAFT MANEUVERS/ STATION-KEEPING/ TECHNOLOGICAL FORECASTING/ TRANSFER ORBITS

ABA: O.C.

ABS: The American Institute of Aeronautics and Astronautics Technical Committees on Liquid Rocket Propulsion and on Space Systems present their evaluation of the development status and prospective mission requirements of U.S. liquid rocket systems. In order to meet the spacecraft mission and payload requirements of the 1990s, four major areas of technological development are identified as requiring further research efforts: launch vehicle technology improvements increasing space utilization and reducing operational costs, high performance systems for the transfer of spacecraft to geosynchronous orbits, high performance space-storable propulsion to increase the effectiveness of planetary and maneuverable spacecraft, and refined station keeping and attitude control propulsion for the prolongation of useful payload life. It is noted that new developments in liquid propulsion technology have slackened as a result of military emphasis on solid rocket motors.

....

83A28693# ISSUE 11 PAGE 1543 CATEGORY 20 83/04/00 10 PAGES UNCLASSIFIED DOCUMENT COPYRIGHT

UTTL: Liquid-rocket propulsion technology

AUTH: A/SACKHEIM, R. L.

PAA: A/(TRW Defense and Space Systems Group, Redondo Beach, CA)

CIO: UNITED STATES; Astronautics and Aeronautics, vol. 21, Apr. 1983, p. 46-52, 54-56.

MAJS: / *LIQUID PROPELLANT ROCKET ENGINES/ *LIQUID ROCKET PROPELLANTS/ *SPACECRAFT PROPULSION/ *TECHNOLOGY ASSESSMENT

MINS: / AUXILIARY PROPULSION/ CRYOGENIC ROCKET PROPELLANTS/ HYDROCARBON FUELS/ LAUNCH VEHICLES/ ORBIT TRANSFER VEHICLES

ABA: V.L.

ABS: The technological advancement needs are defined for the following basic categories of liquid-propulsion systems: launchers and boosters, high-performance orbit-transfer and planetary-injection systems, high-performance space-storable maneuvering systems, high-performance auxiliary systems, and long-term space fluid storage, resupply, and maintenance. It is noted that much of the necessary technology is common to the space stations, orbit-transfer vehicles, and space-based weapons. Coordination of programs will air efficient technology development.

....

82X73602 CATEGORY 20 CNT#: F04611-78-C-0007 81/05/00 28 PAGES UNCLASSIFIED DOCUMENT US GOV AGENCIES

UTTL: Demonstration of low cost nozzleless and nozzled rocket motors

AUTH: A/ROYS, G. P.

CORP: Thiokol Chemical Corp., Huntsville, Ala. In APL The 1981 JANNAF Propulsion Meeting, Vol. 4 p 339-366 (SEE X82-73587 10-20)

CIO: UNITED STATES

MAJS: / *AIR TO AIR MISSILES/ *AIR TO SURFACE MISSILES/ *PROPULSION SYSTEM CONFIGURATIONS/ *PROPULSION SYSTEM PERFORMANCE/ *ROCKET ENGINES/ *ROCKET NOZZLES

MINS: / AERODYNAMIC CHARACTERISTICS/ MILITARY TECHNOLOGY/ TECHNOLOGY ASSESSMENT

....

82A44488*# ISSUE 22 PAGE 3456 CATEGORY 18 82/08/00 6 PAGES UNCLASSIFIED DOCUMENT

UTTL: Advanced rocket propulsion technology assessment for future space transportation

AUTH: A/WILHITE, A. W. PAA: A/(NASA, Langley Research Center, Space Systems Div., Hampton, VA)

CORP: National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

CIO: UNITED STATES; Journal of Spacecraft and Rockets, vol. 19 July-Aug. 1982, p. 314-319.

MAJS: / *LAUNCH VEHICLES/ *PROPULSION SYSTEM PERFORMANCE/ *ROCKET ENGINE DESIGN/ *SPACE TRANSPORTATION/ *SPACECRAFT PROPULSION

MINS: / HYDROCARBON FUELS/ HYDROGEN FUELS/ MASS/ SPACE SHUTTLE MAIN ENGINE/ TECHNOLOGY ASSESSMENET/ TRAJECTORY OPTIMIZATION

AB: (Author)

ABS: Single-stage and two-stage launch vehicles were evaluated for various levels of propulsion technology and payloads. The evaluation included tradeoffs between ascent flight performance an vehicle sizing that were driven by engine mass, specific impulse, and propellant requirements. Numerous mission, flight, and vehicle-related requirements and constraints were satisfied in the design process. The results showed that advanced technology had a large effect on reducing both single- and two-stage vehicle size. High-pressure hydrocarbon-fueled engines that were buried in parallel with two-position nozzle hydrogen-fueled engines reduced dry mass by 23% for the two-stage vehicle and 28% for the single-stage vehicle as compared to an all-hydrogen-fueled system. The dual-expander engine reduced single-stage vehicle dry mass by 41%. Using advanced technology, the single-stage vehicle became comparable in size and sensitivity to that of the two-stage vehicle for small payloads.

....

79X75706*# CATEGORY 20 RPT#: NASA-CR-83069 R-6744 CNT#: NAS8-4013 66/09/00 196 PAGES UNCLASSIFIED DOCUMENT NASA PERS. ONLY

UTTL: Advanced combustion chamber /toroid/ /U/ Final report, Jun. 1965 - Sep. 1966

AUTH: A/LAUFFER, J. R.

CORP: Rockwell International Corp., Canoga Park, Calif.

CIO: UNITED STATES

MAJS: / *COMBUSTION CHAMBERS/ *COOLING SYSTEMS/ *ROCKET ENGINE DESIGN/ *TOROIDS

MINS: / HEAT TRANSFER/ PERFORMANCE TESTS

....

78A11082 ISSUE 1 PAGE 59 CATEGORY 44 77/00/00 4 PAGES UNCLASSIFIED DOCUMENT COPYRIGHT

UTTL: Coal desulfurization by the Battelle Hydrothermal Coal Process

AUTH: A/STAMBAUGH, E. P.; B/MILLER, J. F.; C/TAM, S. S.; D/CHAUHAN, S. P.; E/FELDMANN, H. F.; F/CARLTON, H. E.; G/FOSTER, J. F.; H/NACK, N.; I/OXLEY, J. H.

PAA: I/(Batelle Columbus Laboratories, Columbus, Ohio)

CIO: UNITED STATES

In: Energy development III. (A78-11069 01-44) New York, Institute of Electrical and Electronics Engineers, Inc., 1977, p. 124-127.

MAJS: / *CHEMICAL CLEANING/ *COAL UTILIZATION/ *COST EFFECTIVENESS/ *DESULFURIZING

MINS: / COAL GASIFICATION/ ENERGY TECHNOLOGY/ PYROLYSIS/ SLUDGE/ SYNTHETIC FUELS / SYSTEMS ENGINEERING

ABA: (Author)

ABS: A process for chemical cleaning of coal prior to combustion is the Battelle Hydrothermal Coal Process. This process not only competes favorably on an economic scale with other desulfurization processes, but it also has significant technological advantages. The Battelle Hydrothermal Coal Process should produce no significant amount of sludge for disposal. Its primary end products are clean solid fuel and elemental sulfur - which can be marketed or easily stored - and potentially recoverable metal values. In addition, the Battelle Hydrothermal Coal Process, or modifications of the process, has the potential for producing improved feedstocks for gaseous and liquid fuels and for producing coal solutions which could be a source of coal chemicals.

....

74N71316* CATEGORY 99 RPT#: NASA-CR-136600 R-3962 CNT#: NAS8-4013 63/01/00 65 PAGES UNCLASSIFIED DOCUMENT

UTTL: Evaluation of advanced combustion chamber (toroid). Volume 1: Summary

TLSP: Final Report

CORP: Rockwell International Corp., Canoga Park, Calif. AVAIL.NTIS

CIO: UNITED STATES

MAJS: / *COMBUSTION CHAMBERS/ *NOZZLE FLOW

MINS: / ENGINE DESIGN/ HEAT TRANSFER/ REGENERATIVE COOLING

....

74N70964* CATEGORY 99 RPT#: NASA-CR-136625 R-3962-VOL-2 CNT#: NAS8-4013 63/01/00 319 PAGES UNCLASSIFIED DOCUMENT

UTTL: Evaluation of advanced combustion chamber (toroid), volume 2

TLSP: Final Report

CORP: Rockwell International Corp., Canoga Park, Calif. AVAIL.NTIS

CIO: UNITD TATES

MAJS: / *COMBUSTION CHAMBERS/ *ENGINE DESIGN/ *ROCKET ENGINES

MINS: / AERODYNAMIC CHARACTERISTICS/ HEAT TRANSFER/ TOROIDS

....

74A12920# ISSUE 2 PAGE 251 CATEGORY 28 RPT#: AIAA PAPER 73-1179 73/11/00 10 PAGES UNCLASSIFIED DOCUMENT COPYRIGHT

UTTL: Linear rocket engine design-fabrication-testing

AUTH: A/FULLER, P. N.

PAA: A/(Rockwell International Corp., Rocketdyne Div., Canoga Park, Calif.)

SAP: MEMBERS, $1.50; NONMEMBERS, $2.00

CIO: UNITED STATES American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 9th, Las Vegas, Nev., Nov. 5-7, 1973, AIAA 10 p.

MAJS: / *PROPULSION SYSTEM CONFIGURATIONS/ *ROCKET ENGINE DESIGN/ *SPIKE NOZZLES/ * THRUST CHAMBERS

MINS: / AEROSPACE SYSTEMS/ ELECTROFORMING/ FABRICATION/ PROPULSION SYSTEM PERFORMANCE/ ROCKET PLANES/ ROCKET TEST FACILITIES

ABA: (Author)

ABS: A new rocket engine concept that is presently being evaluated offers significant performance, cost and configurational advantages. The Linear Rocket Engine System combines the unique performance and operational advantages of the aerospike nozzle with the configuration versatility of low-cost modular combustors, which results in a high-performance rocket engine package designed specifically for use in advanced configuration vehicles. This paper describes the design, fabrication, and testing of the Linear Engine System concept to evaluate its potential for vehicle integration. The program was conducted under the sponsorship of NASA's Marshall Space Flight Center.

....

74A11559* ISSUE 1 PAGE 120 CATEGORY 28 RPT#: SAE PAPER 730944 73/10/00 13 PAGES UNCLASSIFIED DOCUMENT COPYRIGHT

UTTL: Linear rocket engine design-fabrication-testing

AUTH: A/FULLER, P. N.

PAA: A/(Rockwell International Corp., Rocketdyne Div., Canoga Park, Calif.)

SAP: MEMBERS, $1.25; NONMEMBERS, $2.00

CIO: UNITED STATES Society of Automotive Engineers, National Aerospace Engineering and Manufacturing Meeting, Los Angeles, Calif., Oct. 16-18, 1973, 13 p. NASA-sponsored research.

MAJS: / *COMBUSTION CHAMBERS/ *ENGINE TESTS/ *PROPULSION SYSTEM CONFIGURATIONS/ * ROCKET ENGINE DESIGN/ *SPIKE NOZZLES

MINS: / FABRICATION/ MODULES/ NOZZLE DESIGN/ PROPULSION SYSTEM PERFORMANCE/ ROCKET NOZZLES

ABA: (Author)

ABS: A new rocket engine concept that is presently being evaluated offers significant performance, cost, and configurational advantages. The Linear Rocket Engine System, (LRES) combines the unique performance and operational advantages of the aerospike nozzle with the configuration versatility of low cost modular combustors, which results in a high-performance rocket engine package designed specifically for use in advanced configuration vehicles. This paper describes the design, fabrication, and testing of the LRES concept to evaluate its potential for vehicle integration. The program was conducted under the sponsorship of NASA's Marshall Space Flight Center.

....

73N12847* ISSUE 3 PAGE 349 CATEGORY 28 72/08/00 12 PAGES UNCLASSIFIED DOCUMENT

UTTL: Engineering advances in aerospike rocket engines

UNOC: Performance, combustion stability, and combustion efficiency of aerospike rocket engines

AUTH: A/BAILEY, R.

CORP: National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala. In its Res. Achievements Rev., Vol. 4, No. 6 p 75-86 (SEE N73-12840 03-27)

CIO: UNITED STATES

MAJS: / *COMBUSTION EFFICIENCY/ *COMBUSTION STABILITY/ *PERFORMANCE/ *ROCKET ENGINES

MINS: / ENGINE DESIGN/ NOZZLE EFFICIENCY/ REGENERATIVE COOLING

ABA: E.H.W.

ABS: The advantages, disadvantages, and improvements in the design of aerospike rocket engines are discussed. Data cover (1) combustion efficiency, (2) aerospike nozzle performance, (3) steady state and dynamic operation of full size thrust chambers, (4) combustion stability, and (5) regenerative cooling of combustor and nozzle walls.

....

73N12840* #ISSUE 3 PAGE 348 CATEGORY 27 RPT#: NASA-TM-X-64690 72/08/00 138 PAGES UNCLASSIFIED DOCUMENT

UTTL: Research Achievements Review, volume 4, no. 6: Chemical propulsion research at MSFC

UNOC: Performance, stability, and design of aerospike engines and engine system components

CORP: National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala. AVAIL.NTIS

SAP: HC $9.00

CIO: UNITED STATES

MAJS: / *CHEMICAL PROPULSION/ *COMBUSTION STABILITY/ *ENGINE DESIGN/ *PERFORMANCE TESTS/ *ROCKET ENGINES

MINS: / CONTROL EQUIPMENT/ NOZZLE DESIGN/ PROPULSION SYSTEM PERFORMANCE/ SYSTEMS ENGINEERING/ THRUST CHAMBERS/ TURBOMACHINERY

ANN: Detailed summaries highlighting the scope and intensity of work done, and being done in combustion stability, liquid/gas hydrogen pumping, nozzles, fluid flow system components, and aerospike engine thrust are presented.

....

No: P1.1 **Title:** Fully Throttleable Engines (multi-phase)

Operations Requirement:

Design and develop main propulsion system rocket engines that are fully throttleable from near 0 to 100%.

Rationale:

The SSMEs can be throttled only from 65% to over 100%. With multiple restart and lower thrust capability, the MPS could be used for orbital maneuvering and de-orbit (OMS); thereby saving cost, weight, and T&C/O of separate OMS systems. For upper stages, this is possibly an alternative to simple pressure-fed engines, but has higher related operations cost, since it doesn't eliminate turbopumps.

Sample Concept:

Use tank-head start phase. Add a percentage of propellant to the chamber with a turbopump to increase mass flow. Gradually delete pressure-fed component to achieve maximum propellant mass flow. Thrust can then be tailored to mission profile to accommodate acceleration requirements.

Technology Requirement:

Must develop:

1. SSME multiple restart capability
   - Spark plug/arc
   - Hot resistor
2. Throttleability
   - Multi-phase concept
     - o Pressure fed
     - o Turbopump assist
     - o Full turbopump
   - Multi-segment toridal chamber
3. MPS propellant acquisition technique for Zero-G restart

Technology References:

NASA/RECON: 84X10295

See P1.

84X10295*# ISSUE 6 CATEGORY 20 82/10/00 11 PAGES UNCLASSIFIED DOCUMENT US GOV AGENCIES AND CONTRACTORS

UTTL: Engines with broad range of thrust change

AUTH: A/MIKHAYLOV, V. V.; B/BAZAROV, V. G.

CORP: National Aeronautics and Space Administration, Washington, D.C. In its Sci. Readings on Aviation and Astronautic, 1980 p 140-150 (SEE X84-10282 06-82)

CIO: U.S.S.R. Transl. into ENGLISH of the mono. '"Nauchnyye Chteniya po Aviatsi i Kosmonavike, 1980'' Moscow, Nauka Press. 1981 p 113-121

MAJS: / *LIQUID PROPELLANT ROCKET ENGINES/ *ROCKET ENGINE CONTROL/ *ROCKET ENGINE DESIGN/ *THROTTLING/ *VARIABLE THRUST

MIN: / AUTOMATIC CONTROL/ COMBUSTION CHAMBERS/ FUEL CONSUMPTION/ FUEL SPRAYS/ PROPULSION SYSTEM PERFORMANCE

ABA: Author

ABS: Implementation of a smooth change in engine thrust over a broad range significantly expands the experimental potentialities of the liquid propellant rocket engines. Problems in the design of the liquid-propellant jet engines with this smooth change in their thrust are examined. An analysis is made of different methods of regulating the thrust which guarantee satisfactory economy and stability of the combustion. The design of the jets an data from testing combustion chambers equipped with them which guarantee 15-fold throttling of the thrust are described.

....

No: P1.2 **Title:** Soft Engine Start

Operations Requirement:

Revise rocket engine start-transient time specifications to provide significantly lower thrust build-up rate.

Rationale:

Existing SSME rapid start can reduce life expectancy and increase refurbishment frequency of turbopump bearings, seals, and propellant valves.

Sample Concept:

Same as Operations Requirement above.

Technology Requirement:

None

Technology References:

See P1.

No: P1.3 **Title:** TVC by Delta Thrust and/or RCS/or Aero

Operations Requirement:

Provide TVC or some form of vehicle attitude control during MPS operation if gimballed engines are eliminated.

Rationale:

Simplifying the vehicle systems and ground operations by deleting gimballed engines and associated systems requires alternate method of TVC or vehicle attitude control during MPS operation as proposed in Item P1.

Sample Concept:

Using multi-engine concept, and off-center thrust vectors, use differential throttling for trajectory control. Accept less than "normal" TVC angle specifications. Possible use of aerodynamic surfaces, also.

Technology Requirement:

Throttleable engines; see items P1.1 and P2 concepts.

Technology References:

NASA/RECON:

87N16551,	87N11735,	87A33249,	87A32117,	87A19603,	86X75348,
86A28490,	85X74761,	85X73876,	85N22229,	85A45971,	85A41019,
85A39562,	85A24795,	84X77582,	84X72233,	84X10357,	84N72750,
84N24603,	84N12237,	84K10744,	84K10153,	84A43401,	84A40143,
84A29544,	84A29543,	84A26701,	84A16526,	84A11999,	83A11175

87N16551# ISSUE 8 PAGE 1092 CATEGORY 63 RPT#: AD-A174250 86/06/00 129 UNPAGES CLASSIFIED DOCUMENT

UTTL: An introduction to artificial intelligence and its potential use in space systems

TLSP: M.S. Thesis

AUTH: A/MCDONALD, GARY W.

CORP: Naval Postgraduate School, Monterey, Calif.

AP: Avail: NTIS HC A07/MF A01

CIO: UNITED STATES

MAJS: / *AEROSPACE SYSTEMS/ ARTIFICIAL INTELLIGENCE/ *COMPUTER VISION/ *DATA PROCESSING/ *PATTERN RECOGNITION/ *ROBOTICS

MINS: / AEROSPACE ENGINEERING/ AUTOMATIC CONTROL/ GROUND STATIONS/ NATURAL LANGUAGE (COMPUTERS)/ SPACE COMMUNICATION/ SPACE MISSIONS/ SYSTEMS INTEGRATION

ABA: GRA

ABS: This survey of Artificial Intelligence (AI) is based upon a review of it history, its philosophical development, and subcategories of its current technologies. These subcategories are expert systems, natural language processing, computer vision and pattern recognition, and robotics and autonomous vehicles. Emphasis is then directed toward the description of the fundamental characteristics of a generic space system, including the space bus components, mission system components, ground node functions, and system missions. It is concluded tat AI, in site of its immaturity as a science, will prove to be a beneficial component of future space systems.

....

87N11735*# ISSUE 3 PAGE 306 CATEGORY 61 84/00/00 11 PAGES UNCLASSIFIED DOCUMENT

UTTL: A nonlinear programming method for system design with results that have been implemented

AUTH: A/HAUSER, F.

CORP: Boeing Aerospace Co., Seattle, Wash.

SAP: Avail: NTIS HC A22/MF A01 In NASA. Langley Research Center Recent Experiences in Multidisciplinary Analysis and Optimization, Part 1, 11 p (SEE N87-11717 03-05)

CIO: UNITED STATES

MAJS: / *COMPUTER AIDED DESIGN/ *COMPUTER PROGRAMS/ *DESIGN ANALYSIS/ *OPTIMIZATION / *STRUCTURAL DESIGN/ *SYSTEMS ENGINEERING

MINS: / AUTOMATIC PILOTS/ ICEBERGS/ PROPULSION/ REENTRY VEHICLES/ SPACE SHUTTLES / SURFACE EFFECT SHIPS

ABA: R.J.F.

ABS: A general nonlinear programming algorithm (NICO) is discussed. An academic optimization example is given. The NICO multi-input, multi-output control system design is discussed. NICO applications relative to launch vehicle autopilot design, space shuttle static balance, transient response criteria in the design of a reentry vehicle control system, and waterjet propulsion and lift system components sized to a large surface effect ship are noted.

....

87A33249 ISSUE 13 PAGE 2046 CATEGORY 63 86/00/00 480 PAGES UNCLASSIFIED DOCUMENT

UTTL: Adaptive methods for control system design — Book

AUTH: A/GUPTA, MADAN M.; B/CHEN, CHI-HAU PAA: A/(Saskatchewan, University, Saskatoon, Canada); B/(Southeastern

Massachusetts University, North Dartmouth, MA) PAT: A/ED.; B/ED.

SAP: Members, $44.95; nonmembers, $59.95

CIO: CANADA; New York, IEEE Press, 1986, 480 p. No individual items are abstracted in this volume.

MAJS: / *ADAPTIVE CONTROL/ *CONTROL SYSTEMS DESIGN/ *OPTIMAL CONTROL

MINS: /AIRCRAFT CONTROL/ ALGORITHMS/ AUTOMATIC PILOTS/ LIAPUNOV FUNCTIONS/ LINEAR SYSTEMS/ MATRICES (MATHEMATICS)/ MODEL REFERENCE ADAPTIVE CONTROL/ NOISE MEASUREMENT/ PROCESS CONTROL (INDUSTRY)/ RANDOM NOISE/ REGULATORS/ ROBOTICS/ ROBOTS/ SELF ADAPTIVE CONTROL SYSTEMS/ STOCHASTIC PROCESSES

AB: C.D.

ABS: A collection of reprint papers is presented which covers the adaptive methods in feedback control systems that have been developed over the past two decades. Historical perspectives and surveys on adaptive control are given, and the theory for the design of model reference adaptive systems and self-tuning regulators is discussed. Adaptive control of uncertain plants using dual control and related approaches is covered. The applications to aircraft control problems, adaptive autopilots, and process control, robotics and other fields re addressed.

....

87A32117 ISSUE 13 PAGE 2044 CATEGORY 63 87/02/00 6 PAGES UNCLASSIFIED DOCUMENT

UTTL: Control operations in advanced aerospace systems

AUTH: A/GRAHAM, WILLIAM R. PAA: A/(R&D Associates, Marina Del Rey, CA)

CIO: UNITED STATES; (IFAC, Symposium on Control of Distributed Parameter Systems, Los Angeles, CA, June 30-July 2, 1986) IEEE Control Systems Magazine (ISSN 0272-1708), vol. 7, Feb. 1987, p. 3-8.

MAJS: / *AEROSPACE SYSTEMS/ *AIRCRAFT CONTROL/ *AUTOMATIC CONTROL/ *CONTROL CONFIGURED VEHICLES/ *DISTRIBUTED PARAMETER SYSTEMS/ *LARGE SPACE STRUCTURES

MINS: /AIR BREATHING ENGINES/ ALPHA JET AIRCRAFT/ CONTROL SYSTEMS DESIGN/ EXTRAVEHICULAR ACTIVITY/ GEOLOGICAL SURVEYS/ HUBBLE SPACE TELESCOPE/ NASA SPACE PROGRAMS/ ROBOTICS

ABA: M.S.K.

ABS: Distributed parameter control systems being studied by NASA for use in advanced aerospace systems are described. A 15 m diameter antenna that will be deployed in space from a 2 cu. m box has 96 control cables for controlling the shape of the antenna. Appropriate near and far-field tests are needed for tuning the shape of the antenna on-orbit. The Space Station will be dynamically stabilized, damped and pointed with a high degree of accuracy, performed to a high degree by automated systems that adapt to a growing structure. Self-diagnosis is also a necessary feature of future EVA equipment and telerobotics, the latter assuming greater importance in a Rover for exploring the surface of Mars. The concepts are being implemented in the X-29 forward swept wing aircraft, the electronics of the Hubble Space Telescope, and in studies of the national aerospaceplane.

....

87A19603* ISSUE 6 PAGE 741 CATEGORY 18 86/00/00 400 PAGES UNCLASSIFIED DOCUMENT

UTTL: Artificial intelligence for Space Station automation: Crew safety, productivity, autonomy, augmented capability — Book

AUTH: A/FIRSCHEIN, O.; B/GEORGEFF, M. P.; C/PARK, W.; D/CHEESEMAN, P. C.; E/GELDBERG, J. PAA: E/(NASA, Advanced Technology Advisory Committee, Houston, TX; SRI International, Menlo Park, CA)

CORP: National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.; SRI International Corp., Menlo Park, Calif.

SAP: $48

CIO: UNITED STATES; Research sponsored by NASA. Park Ridge, NJ, Noyes Publications, 1986, 400 p.

MAJS: / *ARTIFICIAL INTELLIGENCE/ *AUTOMATIC CONTROL/ *SPACE STATIONS/ *TECHNOLOGY ASSESSMENT

MINS: /AEROSPACE TECHNOLOGY TRANSFER/ EXPERT SYSTEMS/ INFORMATION SYSTEMS/ MAN MACHINE SYSTEMS/ MEMORY (COMPUTERS)/ NASA SPACE PROGRAMS/ RESEARCH AND DEVELOPMENT/ ROBOTICS/ SPACE COMMERCIALIZATION/ TELEOPERATORS

ABA: K.K.

ABS: Artificial intelligence (AI) R&D projects for the successful and efficient operation of the Space Station are described. The book explores the most advanced AI-based technologies, reviews the results of concept design studies to determine required AI capabilities, details demonstrations that could indicate the existence of these capabilities, and develops an R&D plan leading to such demonstrations. Particular attention is given to teleoperation and robotics, sensors, expert systems, computers, planning, and man-machine interface.

....

86X75348# CATEGORY 19 RPT#: AD-B099257L TR-0086(6460-02)-1 SD-TR-85-66 CNT#: F04701-85-C-0086 86/02/04 21 PAGES UNCLASSIFIED DOCUMENT US GOV AGENCIES

UTTL: Integrated launch vehicle and spacecraft avionics: A feasible option

TLSP: Final Report

AUTH: A/GILCHRIST, J. D.

CORP: Aerospace Corp., El Segundo, Calif. CSS: (Guidance and Control Div.) MFC: 00

CIO: UNITED STATES

MAJS: / *ACCELERATION (PHYSICS)/ *AUTOMATIC CONTROL/ *AVIONICS/ *INERTIAL GUIDANCE/ * LAUNCH VEHICLES/ *NAVIGATION/ *SPACECRAFT COMPONENTS/ *SPACECRAFT CONTROL/ * SPACECRAFT GUIDANCE

MINS: / COMMAND GUIDANCE/ FEASIBILITY ANALYSIS/ OPTIONS/ REQUIREMENTS

....

86A28490* ISSUE 12 PAGE 1651 CATEGORY 8 CNT#: NAG1-288 CUT OFF 1 LINE AGRECALL AIN FROM ORIG. VSN.

UTTL: An expert planner for the dynamic flight environment

AUTH: A/CHEN, D. C. PAA: A/(E-Systems, Inc., Garland Div., Dallas, TX)

CORP: E-Systems, Inc., Dallas, Tex.

CIO: UNITED STATES; IN: NAECON 1985; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 20-24, 1985. Volume 2 (A86-28326 12-04). New York, Institute of Electrical and Electronics Engineers, 1985, p. 1347-1354.

MAJS: / *AUTOMATIC PILOTS/ *COMPUTERIZED SIMULATION/ *EXPERT SYSTEMS/ *FLIGHT PATHS / *FLIGHT PLANS/ *ROBOTS

MINS: /AIRCRAFT ACCIDENTS/ AIRCRAFT HAZARDS/ TRAJECTORY CONTROL

ABA: Author

ABS: This paper presents a robust robot planner that functions in the complex and dynamic flight domain. The robot pilot flies an aircraft between two airports and can adjust in flight to changes in the environment such as closed destination airport, thunderstorm in the flight path, and failed engine. The planner adjusts to the world changes by locally patching around the break point instead of complete replanning. The planning architecture is based on the vertical decomposition of domain knowledge, resulting in shallow planning and recovery planning. This robot flight planner can be utilized as the front end of an intelligent flight monitor. The flight planner dynamically generates the references that are used to determine whether the flight crew should be notified of potential problems. The implementation of this robot planner is also discussed.

....

85X74761 CATEGORY 60 RPT#: JPRS-UCC-85-008-L 85/04/03 156 PAGES UNCLASSIFIED DOCUMENT US GOV AGENCIES

UTTL: USSR report: Cybernetics, computers and automation technology

CORP: Joint Publications Research Service, Arlington, Va.

CIO: U.S.S.R. Transl. into ENGLISH from various Russian articles

MAJS: / *AUTOMATIC CONTROL/ *COMPUTATION/ *COMPUTER TECHNIQUES/ *CYBERNETICS/ *DATA BASE MANAGEMENT SYSTEMS/ *INFORMATION THEORY

MINS: /ADAPTIVE CONTROL/ AUTOMATA THEORY/ COMPUTER PROGRAMMING/ COMPUTER SYSTEMS DESIGN/ DATA PROCESSING/ DESIGN/ MICROCOMPUTERS/ OPTIMIZATION/ PROGRAMMING LANGUAGES

....

85X73876# CATEGORY 20 RPT#: AD-B089454L AFWAL-TR-84-3050 CNT#: F33615-83-C-3401 84/08/30 221 PAGES UNCLASSIFIED DOCUMENT US GOV AGENCIES AND CONTRACTORS

UTTL: Selectable thrust rocket/attitude control TLSP: Final Report, Jan. 1983 - Jan. 1984

AUTH: A/SARGENT, W. H.; B/ANDERSON, C.; C/HUBBELL, M.; D/SMEDLEY, K.

CORP: Atlantic Research Corp., Gainesville, Va.

CIO: UNITED STATES; Wright-Patterson AFB, Ohio Air Force Wright Aeronautical Labs.

MAJS: / *AERODYNAMIC CHARACTERISTICS/ *ATTITUDE CONTROL/ *AVOIDANCE/ *DYNAMIC PRESSURE/ *EJECTION SEATS/ *ESCAPE SYSTEMS/ *HIGH ALTITUDE/ *HIGH PRESSURE/ * HIGH SPEED/ *JET CONTROL/ *THRUST CONTROL

MINS: /DECELERATION/DRAG CHUTES/ FLIGHT PATHS/ GAS FLOW/GAS GENERATORS/ HIGH TEMPERATURE GASES/ LOW SPEED/MANIFOLDS/ PROPULSION/ ROCKET ENGINES/ TAIL ASSEMBLIES

....

85N22229*# ISSUE 12 PAGE 1947 CATEGORY 63 85/01/00 20 PAGES UNCLASSIFIED DOCUMENT

UTTL: Evaluation of expert systems

AUTH: A/MCANULTY, M. A.

CORP: Alabama Univ., Birmingham. CSS: (Dept. of Computer and Information Science.) AVAIL.NTIS

SAP: HC A99/MF E03; In Alabama Univ. Res. Rept.: 1984 NASA/ASEE Summer Faculty Fellowship Program (NASA-CR-171317) 20p (SEE N85-22210 12-80)

CIO: UNITED STATES

MAJS: / *ALGORITHMS/ *COMPUTER PROGRAMS/ *EXPERT SYSTEMS/ *LOGIC PROGRAMMING

MINS: / ATTITUDE CONTROL/ NUMERICAL CONTROL/ SPACECRAFT ENVIRONMENTS

ABA: G.L.C.

ABS: The only successful applied area of artificial intelligence is that of expert systems, programs which collect and arrange information about the solution of difficult problems in a well-defined and well-circumscribed area, and are then capable of mimicking expert behavior in finding solutions to new problems. NASA intends to investigate the application of this technology to management and control situations in a space station environment, specifically for power, heat, communications, and attitude control, areas where much of the time human management is laborious, repetitive, and eventually error-prone.

....

85A45971# ISSUE 22 PAGE 3232 CATEGORY 9 RPT#: AIAA PAPER 85-1911 85/08/00 5 PAGES UNCLASSIFIED DOCUMENT

UTTL: The Collins AFDS Maintenance System for the Boeing 757/767 — Autopilot Flight Director System

AUTH: A/GRUETTNER, J. E.

PAA: A/(Rockwell International Corp., Cedar Rapids, IA)

CIO: UNITED STATES - AIAA, Guidance, Navigation and Control Conference, Snowmass, CO, Aug. 19-21, 1985. 5 p.

MAJS: / *AUTOMATIC FLIGHT CONTROL/ *AUTOMATIC PILOTS/ *ELECTRONIC EQUIPMENT TESTS/ * IN-FLIGHT MONITORING/ *MAINTENANCE

MINS: / BOEING 757 AIRCRAFT/ BOEING 767 AIRCRAFT/ ERROR DETECTION CODES/ GROUND TESTS/ SELF TESTS

ABA: Author

ABS: The AFDS maintenance provides a flight line maintenance capability for fault detection and fault isolation. A capability is provided for squawk related testing of a Line Replaceable Unit (LRU). These tests verify operation of the LRU and the establishment of interfaces to that LRU. The Maintenance System contains a self test capability. The Maintenance Control and Display Panel (MCDP) is the centralized maintenance computer located in the equipment bay. The MCDP contains buttons to initiate tests and respond to simple questions and contains a display efficient for communicating abbreviated English language messages. In flight, only faults known to create a Flight Deck Effect are reported. Each of the flight computers provide fault reporting and ground test capability. They provide maintenance data to the MCDP via ARINC 429 Buses.

....

85A41019# ISSUE 19 PAGE 2756 CATEGORY 8 84/00/00 11 PAGES; In JAPANESE; UNCLASSIFIED DOCUMENT

UTTL: Optical technology for flight control systems

AUTH: A/MAYANAGI, M.

CIO: JAPAN; Japan Society for Aeronautical and Space Sciences, Journal (ISSN 0021-4663), vol. 32, no. 369, 1984, p. 583-593. In Japanese.

MAJS: / *AUTOMATIC FLIGHT CONTROL/ *CONTROL SYSTEMS DESIGN/ *ONBOARD DATA PROCESSING/ *OPTICAL EQUIPMENT/ *STABILITY AUGMENTATION/ *TECHNOLOGY ASSESSMENT

MINS: /ACTIVE CONTROL/CONTROL CONFIGURED VEHICLES/DIGITAL TRANSDUCERS/ FIBER OPTICS/ OPTICAL DATA PROCESSING

ABA: S.H.

ABS: Optical applications to the flight control system including optical data bus, sensors, and transducers are analyzed. Examples of optical data bus include airborne light optical fiber technology (ALOFT), F-5E, YC-14, YA-7D, MIL-STD-1553 fiber optic data bus, and NAL-optic data bus. This NAL (National Aerospace Laboratory)-optic data bus (based on the MIL-STD-1553B) is applied to STOL, and its characteristics are stressed. Principles and advantages of optical pulse-digital transducers are discussed.

....

85A39562# ISSUE 18 PAGE 2625 CATEGORY 8 85/08/00 10 PAGES UNCLASSIFIED DOCUMENT

UTTL: Robust missile autopilot design using a generalized singular optimal control technique

AUTH: A/LIN, C.-F.; B/LEE, S. P. PAA: A/(Boeing Co., Seattle, WA); B/(Litton Industries, Woodland Hills, CA)

CIO: UNITED STATES; (Guidance and Control Conference, Seattle, WA, August 20-22, 1984, Technical Papers, p. 124-132) Journal of Guidance, Control, and Dynamics (ISSN 0731-5090), vol. 8, July-Aug. 1985, p. 498-507. Previously cited in issue 21, p. 2998, Accession no. A84-43414.

MAJS: / *AUTOMATIC PILOTS/ *MISSILE CONTROL/ *MISSILE TRAJECTORIES/ *OPTIMAL CONTROL / *RADAR HOMING MISSILES/ *TRACKING (POSITION)/ *TRAJECTORY OPTIMIZATION

MINS: / ADAPTIVE CONTROL/ ATTITUDE STABILITY/ CONTROL SYSTEMS DESIGN/ FEEDBACK CONTROL/ FEED FORWARD CONTROL/ ROBUSTNESS (MATHEMATICS)/ TERMINAL GUIDANCE/ TURNING FLIGHT

....

85A24795*# ISSUE 10 PAGE 1347 CATEGORY 18 85/02/00 4 PAGES UNCLASSIFIED DOCUMENT

UTTL: Expanding role for autonomy in military space

AUTH: A/EVANS, D. D.; B/GAJEWSKI, R. R.

PAA: A/(California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA); B/(USAF, Space Technology Center, Kirtland AFB, NM)

CORP: Jet Propulsion Lab., California Inst. of Tech., Pasadena.; Air Force Space Technology Center, Kirtland AFB, N. Mexico.

CIO: UNITED STATES; Aerospace America (ISSN 0740-722X), vol. 23, Feb. 1985, p. 74-77.

MAJS: /*AUTONOMY/ *MILITARY SPACECRAFT

MINS: /AIRBORNE/SPACEBORNE COMPUTERS/ ARTIFICIAL INTELLIGENCE/ EXPERT SYSTEMS/ FAULT TOLERANCE/ ONBOARD DATA PROCESSING

ABA: M.S.K.

ABS: The Jet Propulsion Laboratory is currently transferring satellite on-board autonomy technology to the USAF for use in military spacecraft as a means of lowering the ground support requirements. The techniques were proven on the Viking and Voyager spacecraft and permitted on-board fault detection and correction. New military satellites will incorporate an autonomous redundancy and maintenance management subsystem in an on-board computer, while the system will still be subject to ground-based safing commands for situations demanding deeper analyses. A level 5 autonomy will need 256 kb memory, 10 Mb nonvolatile data storage and 50 W power and will weigh 20 kg. Systems will be periodically checked and compared with an ideal in the data base. Deviations detected will result in a rollback and redundant examination by two microprocessors, which can initiate correction commands until operational criteria are met. The development of the expert systems to the point that they satisfy military specifications is expected to take 10 yr.

....

84X77582# CATEGORY 18 RPT#: AD-B082683L GDC-ASP-83-008-VOL-2 AFWAL-TR-83-3076-VOL-2 CNT#: F33615-81-C-3019 83/07/00 2 VOLS 485 PAGES UNCLASSIFIED DOCUMENT US GOV AGENCIES

UTTL: Advanced Military Spaceflight Capability (AMSC) technology identification study, volume 2

TLSP: Final Report, Aug. 1981 - Mar. 1983

AUTH: A/HEALD, D. A.; B/ANDERSON, D. A.; C/BOWMAN, M. D.; D/BROWER, D. L.; E/IRONS, R. E.

CORP: General Dynamics Corp., San Diego, Calif. CSS: (Convair Div.)

CIO: UNITED STATES; Wright-Patterson AFB, Ohio AFWAL

MAJS: / *AERODYNAMIC CONFIGURATIONS/ *LAUNCH VEHICLES/ *LAUNCHING/ *MILITARY SPACECRAFT/ *PROPULSION/ *REENTRY VEHICLES/ *ROCKET ENGINES/ *SINGLE STAGE TO ORBIT VEHICLES/ *SPACE FLIGHT/ *SYSTEMS ANALYSIS

MINS: /AERODYNAMIC STABILITY/ AIR LAUNCHING/ COST ANALYSIS/ CRYOGENIC FLUIDS/ LAUNCHING SITES/ MAINTAINABILITY/ RENDEZVOUS SPACECRAFT/ SPACE MISSIONS/ SPACE SHUTTLE PAYLOADS/ SPACECREWS/ TAKEOFF/ TECHNOLOGICAL FORECASTING/ VULNERABILITY

....

84X72233# CATEGORY 4 RPT#: AD-B076609L FTD-ID(RS)T-0935-83 83/08/31 207 PAGES UNCLASSIFIED DOCUMENT US GOV AGENCIES

UTTL: Navigation, guidance and control optimization

CORP: Air Force Systems Command, Wright-Patterson AFB, Ohio. CSS: (Foreign Technology Div.)

CIO: U.S.S.R. Transl. into ENGLISH from mono. "Navigatsiya Navedeniye i Optimizatsiya Upravleniya'' Moscow, 1978 p 1-12

MAJS: / *BOOSTER ROCKET ENGINES/ *CONFERENCES/ *FLIGHT PATHS/ *NAVIGATION/ *ROCKET ENGINE CONTROL/ *SPACECRAFT GUIDANCE/ *SPACECRAFT ORBITS/ *THRUST CONTROL

MINS: /ALGORITHMS/ ATTITUDE CONTROL/CONTROL THEORY/ CONTROLLERS/ LINEAR SYSTEMS/ NAVIGATION/ OPTIMIZATION/ SOVIET SPACECRAFT/ SPACECRAFT MOTION/ SYSTEMS

....

84X10357*# ISSUE 8 CATEGORY 16 84/07/00 14 PAGES UNCLASSIFIED DOCUMENT DOMESTIC

UTTL: Concepts and technology for advanced space transportation systems

AUTH: A/GABRIS, E. A.

CORP: National Aeronautics and Space Administration, Washington, D.C.

SAP: Limited by ITAR In NASA Langley Research Center Advan. in TPS and Struct. for Space Transportation Systems p 1-14 (SEE X84-10356 08-16)

CIO: UNITED STATES

MAJS: / *AEROSPACE VEHICLES/ *LAUNCH VEHICLES/ *MISSIN PLANNING *ORBIT TRANSFER VEHICLES/ *SPACE MISSIONS/ *SPACE TRANSPORTAION SYSTEM/ *SPACECRAFT STRUCTURES

MINS: /ABLATIVE MATERIALS/ AEROBRAKING/ AEROCAPTURE/ ORBITS/ REENTRY VEHICLES/ REUSABLE SPACECRAFT/ SPACECRAFT MANEUVERS/ THERMAL PROTECTION

ABA: A.R.H.

ABS: Future requirements for Advanced Space Transportation Systems (ASTS) are assessed in terms of current NASA mission models. Concepts and technology requirements for ASTS are discussed with particular emphasis on Earth-to-orbit and orbital transfer vehicles. Mission-related technology requirements for flight configurations, flight control, aero heating, and materials and structures are emphasized. Technology drivers for the various missions are identified and key technology issues related to thermal protection systems and structural requiregents are emphasized. Other issues, such as space basing of orbital transfer vehicles (OTV's), expendable or reusable transportation systems, and aero braking for OTV's, are also addressed in relation to thermal protection systems and structural requirements. Time line for technology development for the various flight configurations are included.

....

84N72750# CATEGORY 4 RPT#: PB84-116441 APO-81-1 81/07/00 164 UNPAGES CLASSIFIED DOCUMENT

UTTL: Microwave landing system transition plan

CORP: Federal Aviation Administration, Washington, D.C.

CSS: (Office of Aviation Policy and Plans.) AVAIL.NTIS

CIO: UNITED STATES

MAJS: / *COST ESTIMATES/ *INSTRUMENT LANDING SYSTEMS/ *MICROWAVE LANDING SYSTEMS/ *PUBLIC RELATIONS/ *TECHNOLOGY ASSESSMENT

MINS: /AVIONICS/ ENVIRONMENT EFFECTS/GROUND SUPPORT EQUIPMENT/ PARAMETER IDENTIFICATION/ SCHEDULES/ UPGRADING

....

84N24603# ISSUE 15 PAGE 2265 CATEGORY 12 RPT#: AGARD-CP-350 ISBN-92-835-0349-X AD-A141969 84/01/00 348 PAGES; In ENGLISH and FRENCH; UNCLASSIFIED DOCUMENT

UTTL: Guidance and Control Techniques for Advanced Space Vehicles

CORP: Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). AVAIL.NTIS

SAP: HC A15/MF A01

CIO: FRANCE; Symp. held in Florence, 27-30 Sep. 1983

MAJS: / *ACCURACY/ *ACTUATORS/ *ATTITUDE CONTROL/ *DATA PROCESSING/ *GYROSCOPES/ * NAVIGATION/ *SENSORS/ *SPACE RENDEZVOUS/ *SPACECRAFT CONTROL/ *SPACECRAFT GUIDANCE

MINS: / COMPUTER PROGRAMS/ COST ESTIMATES/ LARGE SPACE STRUCTURES/ MICROPROCESSORS/ OPTIMIZATION/ ORBITAL POSITION ESTIMATION/ ORBITAL SERVICING/ SPACECRAFT DOCKING/ SPACECRAFT MANEUVERS

ANN: This symposium dealt with spacecraft problems, the topic being guidance and control techniques for advanced space vehicles. Military applications of space for navigation, communication and intelligence impose increasing requirements on spacecraft capacity, orbit control and pointing accuracy. To meet the requirements for future spacecraft the performance of existing components, such as actuators and sensors, is improved or new concepts are developed. In particular the use of microprocessors and other data distribution systems permits multifunctional use of various sensors or information sources to produce effective, survivable systems at low cost. Increasing on-board computing capacity enables the use of sophisticated software for effective complex spacecraft control. A unique aspect of large spacecraft is the control of the structural configuration in order to achieve a specific pointing accuracy. Large structures, with their mechanical flexibility, present particular problems to the control engineer and control/structure interaction (CSI) is a driving force in many current programs and figured largely in the papers presented. For individual titles, see N84-24604 through N84-24626.

....

84N12237*# ISSUE 3 PAGE 345 CATEGORY 20 83/12/00 6 PAGES UNCLASSIFIED DOCUMENT

UTTL: Combined attitude control and energy storage

AUTH: A/HOFFMAN, H.

CORP: National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md. AVAIL.NTIS

SAP: HC A10/MF A01 In NASA. Langley Research Center Integrated Flywheel Technol., 1983 p 93-98 (SEE N84-12228 03-20)

CIO: UNITED STATES

MAJS: / *ATTITUDE CONTROL/ *ENERGY STORAGE/ *FLYWHEELS/ *SYSTEMS INTEGRATION

MINS: /FAILURE MODES/ KINETIC ENERGY/ MATRICES (MATHEMATICS)/ REDUNDANCY ENCODING/ SPIN STABILIZATION/ TORQUERS

ABA: B.G.

ABS: The effect on attitude control by multiple wheels (used for energy storage) is described.

....

84K10744 (Mod-005) CNT#: NAS1-17633 DUN#: 008383812 CIC#: 2053502 National Aeronautics and Space Administration. Langley Research Center, Hampton, Va. Rockwell International Corp., Downey, Calif.

UTTL: The applicability of composite materials technology to an attitude control and energy storage system UNCLASSIFIED JANUARY 30, 1984 / JULY 31, 1985

TM: A/WILLIAMS, J. L. A/161 REPORTS EXPECTED

MAJS: /*AERODYNAMIC DRAG/ *ATTITUDE CONTROL/ *COMPOSITE MATERIALS/ CRYOGENIC FLUIDS/ *ENERGY STORAGE/ *FLYWHEELS/ *LIFE CYCLE COSTS/ *MAGNETIC BEARINGS/ *MASS RATIOS/ *MATHEMATICAL MODELS/ *MOMENTUM/ *NICKEL HYDROGEN BATTERIES/ * RADIANT FLUX DENSITY/ *REGENERATIVE FUEL CELLS/ *SIZE (DIMENSIONS)/ *SOLAR ARRAYS/ *SPACE STATIONS/ *SPACECRAFT CONTROL/ *SPACECRAFT POWER SUPPLIES/ *TORQUE

....

84K10153 (Mod-005) CNT#: NAS1-17403 DUN#: 041162330 CIC#: 1013309 National Aeronautics and Space Administration. Langley Research Center, Hampton, Va. Textron, Inc., Irvine, Calif.

UTTL: Flight crucial flight control systems state-of-technology survey UNCLASSIFIED JULY 25, 1983 / JUNE 30, 1985

TM: A/SPITZER, C. R. A/472

PI: B/REDIESS, H. REPORTS EXPECTED

MAJS: / *AUTOMATIC FLIGHT CONTROL/ *AVIONICS/ *FLIGHT CONTROL/ *SURVEYS/ *TECHNOLOGY ASSESSMENT

....

84A43401 ISSUE 21 PAGE 3104 CATEGORY 63 84/00/00 780 PAGES UNCLASSIFIED DOCUMENT

UTTL: Guidance and Control Conference, Seattle, WA, August 20-22, 1984, Technical Papers

SAP: Members, $55.; nonmembers, $70

CIO: UNITED STATES; Conference sponsored by the American Institute of Aeronautics and Astronautics. New York, American Institute of Aeronautics and Astronautics, 1984, 780 p. For individual items see A84-43402 to A84-43486.

MAJS: / *CONFERENCES/ *CONTROL THEORY/ *GUIDANCE (MOTION)

MINS: / AEROASSIST/ AIRCRAFT CONTROL/AUTOMATIC PILOTS/ COMMAND GUIDANCE/ COMPUTERIZED SIMULATION/ CONTROL SYSTEMS DESIGN/ FEEDBACK CONTROL/ FLIGHT CONTROL/ GLOBAL POSITIONING SYSTEM/ INERTIAL NAVIGATION/ OPTIMAL CONTROL/ OPTIMIZATION/ ORBITAL SERVICING/ POINTING CONTROL SYSTEMS/ PROPELLANT TANKS/ RADAR HOMING MISSILES/ SPACE NAVIGATION/ SPACECRAFT CONTROL/ STRAPDOWN INERTIAL GUIDANCE

ABA: O.C.

ABS: Among the guidance and control topics discussed are autonomous spacecraft navigation, aeroassisted orbital plane change, spacecraft applications of inertial energy storage wheels, miss distance dynamics in homing missiles, robust missile autopilot design, the Space Telescope Alternate Fine Guidance Sensor, instrument failure detection and isolation in a system with variable plant parameters, the control of forward swept wing configurations dominated by flight dynamic-aeroelastic interactions, Global Positioning System applications to geodesy, airborne gravity measurement with an astroinertial system, discrete optimal control solutions applicable to missile guidance, and maximum information guidance for homing missiles. Also considered are the analysis of a control concept for ejection seats, large flexible structure controllability improvements, multivari large aircraft, airborne wind shear detection, robust compensator synthesis by frequency-shaped estimation, digital flight mode control systems for high performance aircraft with flight propulsion control coupling, a model-following control system for helicopters, the maneuvering of distributed spacecraft, roll/yaw control of flexible

....

84A40143 ISSUE 19 PAGE 2816 CATEGORY 63 83/00/00 328 PAGES In RUSSIAN UNCLASSIFIED DOCUMENT

UTTL: Aircraft and spacecraft control — Russian book

AUTH: A/PETROV, B. N.

CIO: U.S.S.R.; Moscow, Izdatel'stvo Nauka (B. N. Petrov Izbrannye Trudy. Volume 2), 1983, 328 p. In Russian.

MAJS: / *AIRCRAFT CONTROL/ *CONTROL THEORY/ *FLIGHT CONTROL/ *OPTIMAL CONTROL/ * SPACECRAFT CONTROL

MINS: / AIRCRAFT INSTRUMENTS/ ATTITUDE CONTROL/ AUTOMATIC FLIGHT CONTROL/ FUEL CONTROL/ NAVIGATION INSTRUMENTS/ ONBOARD DATA PROCESSING/ REENTRY GUIDANCE / ROCKET ENGINE CONTROL/ SPACECRAFT INSTRUMENTS/ SYSTEMS ENGINEERING/TERMINAL GUIDANCE/ THRUST CONTROL/ VARIABLE GEOMETRY STRUCTURES

ABA: I.H.

ABS: The second edition of a collection of essays and articles on aircraft and spacecraft control by one of the founders of the Soviet space program is presented. Attention is given to general technical problems of aircraft control systems, including attitude control, control of spacecraft during reentry, and control of aircraft and spacecraft propulsion systems. Some technical issues in the design of automatic flight control systems, flight data management systems on board aircraft and spacecraft, and the application of data processing technology to radiosounding experiments in space are also briefly discussed.

....

84A29544 ISSUE 12 PAGE 1688 CATEGORY 8 RPT#: SAE PAPER 831486 83/00/00 5 PAGES UNCLASSIFIED DOCUMENT

UTTL: Future flight control capability development

AUTH: A/FLINN, E. H. PAA: A/(USAF, Wright-Patterson AFB, OH)

CIO: UNITED STATES; IN: Aerospace fluid power and control systems; Proceedings of the Aerospace Congress and Exposition, Long Beach, CA, October 3-6, 1983 (A84-29540 12-08). Warrendale, PA, Society of Automotive Engineers, Inc., 1983, p. 43-47.

MAJS: / *AIRBORNE/ SPACEBORNE COMPUTERS/ *AIRCRAFT CONTROL/ *AITP,ATOC FLIGHT CONTROL/ *DIGITAL NAVIGATION/ *SYSTEMS INTEGRATION/ *TECHNOLOGICAL FORECASTING

MINS: /ALL-WEATHER AIR NAVIGATION/ ARCHITECTURE (COMPUTERS)/ BOMBER AIRCRAFT/ DATA MANAGEMENT/ FIGHTER AIRCRAFT/ NIGHT FLIGHTS (AIRCRAFT)/ ONBOARD DATA PROCESSING/ REAL TIME OPERATION

ABA: C.R.

ABS: A brief overview of emerging flight control technologies is presented which covers tactical flight management, advanced digital flight control, and integrated reference systems. The fighter-bomber pilot of the future, by using emerging developments in tactical flight management, will be able to operate at night in adverse weather conditions. He will fly and maneuver at low altitudes to achieve survivable penetration and threat avoidance. He will navigate precisely, arriving on time at very specific locations, and will be able to be redirected on a real-time basis to alternate targets of higher priority. In discussing advanced digital control, it is predicted that the impact of the explosion in digital computer development will be to allow the flight control system developer to design system architectures that will offer flexibility in meeting advanced tactical system objectives while providing improvements in system performance, reliability and maintainability.

....

84A29543 ISSUE 12 PAGE 1688 CATEGORY 8 RPT#: SAE PAPER 831485 83/00/00 14 PAGES UNCLASSIFIED DOCUMENT

UTTL: Flight control system development on the B-1 program

AUTH: A/KOZIOL, D. E.; B/BILLIPS, G. C.; C/PETERSEN, F. W. PAA: C/(Rockwell International Corp., El Segundo, CA)

CIO: UNITED STATES; IN: Aerospace fluid power and control systems; Proceedings of the Aerospace Congress and Exposition, Long Beach, CA, October 3-6, 1983 (A84-29540 12-08). Warrendale, PA, Society of Automotive Engineers, Inc., 1983, p. 29-42.

MAJS: / *AIRCRAFT CONTROL/ *B-1 AIRCRAFT/ *FAIL-SAFE SYSTEMS/ *FLIGHT CONTROL/ *FLY BY WIRE CONTROL/ *RELIABILITY ENGINEERING

MINS: / ACTUATORS/ AUTOMATIC FLIGHT CONTROL/ EVOLUTION (DEVELOPMENT)/ FLIGHT SIMULATION/ FLIGHT TESTS/ GROUND TESTS/ MANUAL CONTROL/ TERRAIN FOLLOWING AIRCRAFT

ABA: Author

ABS: The B-1 is a long-range strategic bomber designed to perform safely in a hostile environment with a high probability of mission success. The flight control system achieves these objectives with redundant hybrid combinations of fly-by-wire and conventional design techniques. The primary mode of control in each axis is fail-operational, fail-safe, fly-by-wire with simultaneously operating mechanical control. The flight control system is described, and selected flight and ground test experiences and resultant development activity are discussed. Developments include reduction of force fight in surfaces with multiple actuators, reduction of horizontal stabilizer control hysteresis, elimination of pitch control/structural mode coupling, reduction in lower rudder load oscillations, increase in the operational reliability of the flap/slat system, elimination of the susceptibility of the augmentation system to electrical power transients, and other items.

....

84A26701 ISSUE 11 PAGE 1504 CATEGORY 6 83/00/00 746 PAGES UNCLASSIFIED DOCUMENT

UTTL: Digital Avionics Systems Conference, 5th, Seattle, WA, October 31-November 3, 1983, Proceedings

SAP: Members, $28.; nonmembers, $56

CIO: UNITED STATES; Conference sponsored by the Institute of Electrical and Electronics Engineers and American Institute of Aeronautics and Astronautics. New York, Institute of Electrical and Electronics Engineers, 1983, 746 p.

MAJS: / *AIRBORNE/ SPACEBORNE COMPUTERS/ *AVIONICS/ *CONFERENCES/ *DIGITAL SYSTEMS

MINS: /AIRCRAFT CONTROL/ AUTOMATIC FLIGHT CONTROL/COMMERCIAL AIRCRAFT/ COMPUTER PROGRAMS/ DIGITAL NAVIGATION/ HIGH LEVEL LANGUAGES/ IN-FLIGHT MONITORING/ ONBOARD DATA PROCESSING/ PRODUCT DEVELOPMENT/ ROTORCRAFT AIRCRAFT/ SYSTEMS INTEGRATION/ SYSTEMS SIMULATION/ TECHNOLOGICAL FORECASTING/ V/STOL AIRCRAFT/ VHSIC (CIRCUITS)

ABA: G.R.

ABS: The subjects discussed are related to fault tolerant avionics, avionics support systems, advanced technology for digital systems, management techniques for software development and maintenance, system simulation for effectiveness evaluation, flight experience with digital flight control systems, advanced avionics systems, avionics for V/STOL and rotorcraft, and commercial aircraft systems. Aspects of operational aircraft digital avionics are considered along with VHSIC applications and technology, integrated CNI on-board terminals, integrated map techniques, on-board monitoring and support, sensor and signal processing, new concepts regarding digital flight control systems, data bus techniques and applications, avionics flight software, general aviation avionics, integrated systems, an integrated crew station, and on-board ATC systems. Attention is given to the digital avionics revolution, achievements and challenges with respect to digital avionics standards, digital avionics design decisions involving new commercial transport aircraft, and the digital aircraft from a pilot's perspective. For individual items see A84-26702 to A84-26806

....

84A16526 ISSUE 5 PAGE 535 CATEGORY 1 83/00/00 1565 PAGES UNCLASSIFIED DOCUMENT

UTTL: NAECON 1983; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 17-19, 1983. Volumes 1 & 2

SAP: Price of two volumes, $53.50

CIO: UNITED STATES; Conference sponsored by the Institute of Electrical and Electronics Engineers, Itek Corp., Computer Sciences Corp., et al. New York, Institute of Electrical and Electronics Engineers, 1983, vol. 1, 748 p.; vol. 2, 817 p.

MAJS: / *AEROSPACE SYSTEMS/ *AVIONICS/ *CONFERENCES/ *SPACECRAFT ELECTRONIC EQUIPMENT

MINS: / AIRBORNE/SPACEBORNE COMPUTERS/ AUTOMATIC FLIGHT CONTROL/ DATA SYSTEMS/DIGITAL NAVIGATION/ ELECTRIC POWER SUPPLIES/ ELECTROMAGNETIC COMPATIBILITY / FIRE CONTROL/ KALMAN FILTERS/ MAN MACHINE SYSTEMS/ RADAR TRACKING/ ROBOTICS/ SIGNAL PROCESSING

ABA: B.J.

ABS: Topics discussed include the all electric aircraft; aerospace power systems development; electromagnetic compatibility; robotics; CAD/CAM; air data systems; navigation systems; controls and displays; Kalman filtering and signal processing applications; flat panel display technology; airborne image processing and targeting application; airborne automatic target recognition/acquisition; pointing, tracking, and stabilization; airborne radar and fire control technology; airborne computers and multiplex; advanced avionics systems; and digital systems. Consideration is also given to maintenance trainers, visual and electrooptical sensor simulation; software management and engineering techniques; human/machine system analysis; workload assessment; environmental interactions; physiological/medical interfaces; AFTI/F-16 flight development summary; integrated control; flying qualities; and flight management. For individual items see A84-16527 to A84-16696

....

84A11999 ISSUE 2 PAGE 213 CATEGORY 63 CNT#: STU-82-3430 83/09/00 16 PAGES UNCLASSIFIED DOCUMENT

UTTL: Theory and applications of adaptive control - A survey

AUTH: A/ASTROM, K. J. PAA: A/(Lund Institute of Technology, Lund, Sweden)

CIO: SWEDEN; Automatica (ISSN 0005-1098), vol. 19, Sept. 1983, p. 471-486. Sponsorship: Styrelsen for Teknisk

Utveckling.

MAJS: / *ADAPTIVE CONTROL/ *CONTROL THEORY/ *FEEDBACK CONTROL/ *STOCHASTIC PROCESSES / *TECHNOLOGY ASSESSMENT/ *TECHNOLOGY UTILIZATION

MINS: / AUTOMATIC PILOTS/ BIBLIOGRAPHIES/ CONVERGENCE/ FEASIBILITY ANALYSIS/ PARAMETERIZATION/ REGULATORS/ SYSTEMS STABILITY/ TUNING

ABA: Author

ABS: Progress in theory and applications of adaptive control is reviewed. Different approaches are discussed with particular emphasis on model reference adaptive systems and self-tuning regulators. Techniques for analyzing adaptive systems are discussed. This includes stability and convergence analysis. It is shown that adaptive control laws can also be obtained from stochastic control theory. Issues of importance for applications are covered. This includes parameterization, tuning, and tracking, as well as different ways of using adaptive control. An overview of applications is given. This includes feasibility studies as well as products based on adaptive techniques.

....

83A11175 ISSUE 1 PAGE 13 CATEGORY 8 82/00/00 12 PAGES UNCLASSIFIED DOCUMENT

UTTL: Integrated airframe/propulsion controls technology

AUTH: A/GUPTA, N. K.; B/TRAVASSOS, R. H. PAA: B/(Integrated Systems, Inc., Palo Alto, CA)

CIO: UNITED STATES; In: NAECON 1982; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 18-20, 1982. Volume 2. (A83-11083 01-01) New York, Institute of Electrical and Electronics Engineers, Inc., 1982, p. 780-791.

MINS: / AIRBORNE/SPACEBORNE COMPUTERS/ AIRCRAFT DESIGN/ ARCHITECTURE (COMPUTERS) / CONTROL THEORY/ FAULT TOLERANCE/ MULTIPROCESSING (COMPUTERS)/ PARALLEL PROCESSING (COMPUTERS)

ABA: C.D.

ABS: Integrated aircraft control technologies and issues are examined and potential approaches to integrated airframe/propulsion control development are reviewed. Classical control architecture and the manner in which it meets aircraft control requirements are shown. Aircraft control requirements and emerging technologies which will help meet future mission requirements are discussed. Advanced multivariable control methods such as hierarchical control and frequency-shaping methods which are useful for integrated control computations are described. Integrated control system architectures are addressed, including the Multivariable Control Processor, the Redundant Common Bus Processor, and the Centralized Processor Redundant Actuator/Sensor System.

....

No: P1.4 **Title:** One Oxidizer / One Fuel

Operations Requirement:

Simplify propellant procurement, transport, storage, pumping, safety equipment and procedures by designing vehicles using only one oxidizer and one fuel.

Rationale:

Each individual propellant ground system requires its own little army of engineers, technicians, safety, and expensive, hazardous facilities/GSE.

STS has five propellant components, each of which require separate procurement, transport, storage, pumping , GSE, safety, operational procedures, engineers, technicians, etc.

Sample Concept:

Propellant-related ground support operations and the different vehicle systems test and checkout would be immensely simplified if only one oxidizer and one fuel were required.

Technology Requirement:

Development only.

Technology References:

See P1.

No.: P2 **Title:** Eliminate Separate OMS and RCS

Operations Requirement:

Delete OMS and RCS as separate systems from MPS.

Rationale:

If MPS can be utilized for OMS and RCS, it may significantly lighten vehicle and will simplify ground support operations.

Sample Concept:

Use one of MPS engines at greatly reduced throttle for final orbit insertion and de-orbit. This eliminates separate engines, valves, thrust structure and tankage with a modest increase in on-board MPS tankage.

The integrated propulsion system, for ideal simplicity and minimization of "systems" should include, as a design goal, the attitude control functions of an ERS system.

Concept dependent on booster and orbiter having independent propulsion and tankage as proposed in STAS.

Technology Requirement:

1. Develop throttleable MPS; see P1.1 and P2.

2. Develop orbital restart capability

3. Develop Zero-G propellant acquisition techniques

Technology References:

See P1.

No: P3 **Title:** Eliminate High-Maintenance Turbopumps

Operations Requirement:

The ideal requirement is to eliminate high maintenance turbopumps.

Rationale:

Turbopumps are very costly to develop and manufacture: heavy, very high RPM, cavitation-sensitive devices.

Rocket engine cost, refurbishment frequency, refurbishment cost, and T&C/O time consumption are largely driven by turbopump sensitivity.

Pressure-fed engines with plug nozzles are a viable prospect as specific impulse is relatively insensitive to chamber pressure per se.

Sample Concept:

Develop a low-pressure-fed engine in the interest of providing minimum tankage weight and simplifying associated transport and handling GSE. A non-conventional (plug) nozzle will be necessary to shorten length, reduce weight, and compensate for the low-chamber-pressure thrust deficiency of conventional booster nozzles.

An alternative is to develop a turbopump that is robust and essentially maintenance free.

Technology Requirement:

1. Lightest possible PFLB design (competive with turbopump-type vehicle)
2. Pressure-fed injector design
3. Igniter design
4. Plug nozzle design, toroidal thrust chamber, or other concept to shorten nozzle and increase low altitude thrust coefficient.

Technology References:

See P1.

No.: P4 **Title:** No Hydraulics

Operations Requirement:

Provide high thrust actuators for vehicle systems using a system other than hydraulic.

Rationale:

Hydraulic systems are heavy, complex, and plagued with O&M GSE activities. Vehicle and ground support operations would be greatly simplified if simpler, more reliable alternative is developed.

The following data are provided for processing of STS-31, Orbiter Atlantis, launched November 26, 1985 (flight 23). Data source is the Shuttle II Data Base Development prepared by SPC sub-contractor Pan Am World Services, Inc., dated July 24, 1987.

SCHEDULED MAINTENANCE, SYSTEM 58, HYDRAULICS

OPF OPERATIONS

TASK	MANHOURS
Technician	1,045
Engineering	930
Safety	84
Quality	397
PP&C	230
Support	1,933
Logistics	554
Overhead	439
Total	5,612

NOTES

1. This data for STS-31 only.
2. Headcount 26 (5 techs +21 "other")
3. OPF dwell time 27 days
   VAB dwell time 4 days
   Pad dwell time 15 days
4. Orbiter Challenger was in parallel processing during this period.

VAB INTEGRATION

TASK	MANHOURS
Technician	88 (actual)
Total manhours	473 (ratioed)

NOTES

1. Total manhour-to-tech ratio above, is 5612/1045 = 5.37
2. Headcount 32 (6 techs +26 "other")
3. MLPs contain extensive hydraulics systems for test support subsequent to vehicle erection. During 51-L the 6 techs rotated between the 2 operational MLPs for test support and system O&M.

The hydraulic systems manhours (6085) and headcount (58) identified above are not an obvious burden when compared to a major tentpole such as TPS (57,115 manhours and 264 headcount). However, hydraulics activities are pervasive throughout the entire process. For instance, elevon and body flap areas are TPS-intense work locations, but access by tile techs is denied during any of the numerous repetitive "hydraulics-up" periods.

The following presentation of major hydraulics tasks is intended to provide further insight into the far-reaching impact of flight vehicle hydraulics and associated support.

HYDRAULICS SYSTEMS DEFINITION

The Orbiter hydraulic system consists of three independent hydraulic systems. Each of the three auxiliary power units provides mechanical shaft power to drive a hydraulic pump, and each of the three hydraulic pumps provides the hydraulic pressure for the respective hydraulic system.

Each hydraulic system provides hydraulic pressure for operation of actuators to control orbiter aerosurfaces (elevons, rudder/speedbrake, and body flap), the three main engine gimbals (thrust vector control), main engine valves, external tank umbilical retraction, landing gear deployment, main landing gear brakes and anti-skid control, and nose gear steering.

OPF OPERATIONS

	TIME	TECHS	MHRS
V1010A - Hydraulic System Configuration/Deaeration	8	10	80
V1131 - Hydraulic Accumulator Checks	24	5	120

This task determines the precharge pressures of the Orbiter hydraulic system bootstrap accumulators and the main engine return accumulators and charges the accumulators to flight pressures as required.

	TIME	TECHS	MHRS
V6012 - Orbiter Hydraulic System Check	68	7	476

This task performs a detailed visual inspection of the orbiter hydraulic system for damage from usage, corrosion and mission environment.

	TIME	TECHS	MHRS
V9002 - Orbiter Vehicle Hydraulic Power Up/Down	8	7	56

A. Hydraulic System Preparations and Walkdowns. This task prepares the orbiter to accept external hydraulic power to support hydraulic or associated subsystem testing.

	TIME	TECHS	MHRS
B. Depin Nose Landing Gear	8	6	48

This task removes the attach bolt from the end of the nose landing gear actuator piston rod to prevent inadvertent movement of the nose landing gear.

	TIME	TECHS	MHRS
C. Raise Landing Gear	2	2	4

This task applies external hydraulic power to the orbiter for the purpose of raising the landing gear.

	TIME	TECHS	MHRS
D. Position Aerosurfaces for Rollout	4	4	16

This task secures the flight control aerosurfaces at the completion of processing operations.

	TIME	TECHS	MHRS
E. External Tank External Commands	4	6	24

This task checks the external tank umbilical retraction external commands.

F. Hydraulic Compressibility/Deaeration	8	3	24

This task runs the ground hydraulic power system in advance of its connection to the orbiter to condition the hydraulic fluid to meet established requirements for purity, water content and dissolved air content.

G. Landing Gear Reservoir Fill	4	3	12

This task fills the on-board hydraulic reservoirs with hydraulic fluid.

H. Lower Landing Gear	48	3	144

This task hydraulically extends the left main landing gear.

I. Lower Landing Gear	3	3	9

This task hydraulically extends the right main landing gear.

J. Orbiter Disconnect and Reconfigure to Dedicated Systems	8	4	32

This task disconnects and removes the external hydraulic power and returns the orbiter hydraulic system to a flight readiness configuration.

Total:	197		1,045

VAB INTEGRATION

Note: Manpower quantifiers not available for VAB Integration

V9002. Vol. 1 - OPF - Vehicle Hydraulic Power Up/Down

Applies hydraulic ground power to the Orbiter in the OPF to support hydraulic and associated SVC system testing. Also secures the Orbiter and ground hydraulic systems when hydraulic power is terminated.

V9002. Vol. 2 - MLP - Vehicle Hydraulic Power Up/Down

Applies hydraulic ground power to the Orbiter on the MLP to support hydraulic and associated subsystem testing. Also secures the Orbiter and ground hydraulic systems when hydraulic power is terminated.

V9002. Vol. 3 - Vehicle Hydraulic Circulation Pump Power Up/Down - Reservoir Quantity Adjustments and Sampling.

Applies hydraulic power to Orbiter with onboard circulation pumps.

V9002. Vol. 4 - GSE Hydraulic Power Up/Down

Powers hydraulic ground support equipment to condition hydraulic fluid prior to orbiter power up.

V9002. Vol. 5 - Flight Control and Aerosurface/SSME/OMS Actuator Positioning

Configures the flight control system to support Orbiter hydraulic application for subsequent subsystem testing. Provides aerosurface/SSME/OMS actuator positioning for operational support. Secures the flight control system upo completion of testing or operations.

V9002. Vol. 6 - SSME Power Up/Down

Configures thrust vector control (TVC) actuators and SSME's. Applies SSME helium or controller power to the Orbiter to support hydraulic and associated subsystem testing. Secures SSME's and TVC actuators when hydraulic power is terminated.

V9002. Vol. 7 - Hydraulic Power Up Walkdown/Vehicle Preps.

Prepares Orbiter and work areas to support hydraulic power up.

V9002. Vol. 8 - Vehicle Support Tasks

Performs vehicle support tasks prior to hydraulic power up and after hydraulic power down.

V9002. Vol. 9 - GSE Hydraulic Power Up Preparations

Configures ground support equipment to support hydraulic power up.

V9002. Vol. 10 - S70 - 0952 Flexhose Installation and Removal

Installs hydraulic flexhoses (program model number (PMN) S70-0952) and support trays in the aft Orbiter compartment to support Orbiter hydraulics.

V5057 - TVC/SSME GSE Installation/Removal

Procedures for the installation, use, and removal of ground support equipment (GSE) used for testing of the space shuttle main engine (SSME), hydraulics, and guidance, navigation, and control (GN&C) subsystems.

S0008 - Shuttle Interface Test 9 (LPS)

Functional checks performed from the firing room to verify: 1) orbiter/MLP interfaces, 2) orbiter/ET electrical and fluid system interfaces, 3) Orbiter/SRB interfaces, and 4) operation of the SRB systems.

S0020 - Shuttle Flight Control Integrated Tests (LPS)

Interface checkout and functional tests of the SRB flight control system from the firing room.

V9005 - Hydraulic Standard Power Up/Power Down

Provides 3000 PSI ground hydraulic pressure to the Orbiter for operation of aerosurfaces, body flap, thrust vector control (TVC) actuators, landing gear retraction/extension, and other hydraulic operations.

V1149 - T-0 Umbilicals Interface Leak Checks

Performs leak checks of the interfaces between the Orbiter/external tank and the umbilicals which disconnect at the zero second countdown (T-0) at launch. Also checks the timing of the disconnect valves and verification of purge of LO2/LH2 from the disconnect cavities. Checks are performed after umbilicals are mated to the Shuttle system but prior to introduction of any fluids through the umbilicals.

S5008 - Orbiter/ET Umbilical Mate

Connects umbilicals to the Orbiter and ET. Installs umbilical purge curtains at the Orbiter/ET interfaces and configures Ground Support Equipment (GSE) to monitor ET tank pressure.

S0004 - Orbiter/ET Mate

Lifts the Orbiter in horizontal position and retracts the landing gear. Rotates the Orbiter to vertical position, extends access platforms, and mates the Orbiter to the ET. Mates Orbiter ET umbilicals in accordance with OMI S5008.

PAD OPERATIONS

S0024 - Prelaunch Propellant Servicing

Controls and sequences the following tasks on the Integrated shuttle at the pad:

1. Load hydraulic and nitrogen for each APU prior to flight.

2. Service the SRB hydraulic power unit with hydrazine and gaseous nitrogen.

3. Perform SRB hydraulic power unit hit fire.

Sample Concept:

State-of-the-art high-torque electric motors coupled to low-friction ball-worm linear actuators and high-leverage mechanical linkage hold promise of great simplification for ground support operations.

Technology Requirement:

Develop motors with ball-worm actuators and self-test status reporting for specific applications.

Technology References:

Design development only.

Conclusions:

Ground support to flight hydraulics is a surprisingly large, ill-defined tentpole. Innovative design and development of an alternate energy source promises to provide a significant reduction in KSC shuttle-equivalent headcount and GSE. The resulting simplification of processing procedures and operations, unquantifed by this study, can produce a very significant enhancement to the ground processing operations. The hydraulics timeline, as shown above, requires 197 hours in the OPF alone (25 shifts).

If hydraulics can be replaced with self-tending, health-and-status reporting electro-mechanical systems, it appears realistic the VAB hydraulics support force (32 people) and about 20% of the OPF O&M support (5) can be eliminated from a future launch vehicle (theoretically converting OPF hydraulics support to electro-mechanical actuator O&M). This represents a decrease in shuttle-equivalent headcount of 37 people or 37/58 = 64%.

No: P5 **Title**: No Hypergols

Operations Requirement:

No hypergols for launch, orbital propulsion, or APU systems.

Rationale:

A very significant quantity of non-productive manhours occurs during each flow for "area clear" required during hazardous opening/entry/operation of OMS and RCS orbiter systems. There is also a snowballing effect in facilities and O&M requirements for special ventilation, scrubbers and a multitude of safety equipment, including a small army to use and maintain SCAPE (self-contained atmospheric protective ensemble) suits.

The cost of hypergolic propellants is also a factor. For comparison, a pound of MMH or N2H4 hypergol costs $10.00, and N204 costs $2.75/lb., whereas LOX costs $0.04/lb; RP-1 - $0.50/lb; C3H8 - $0.27/lb, CH4 - $0.71/lb, LH2 - $1.62/lb, and 90% H2O2 - $3.20/lb.

SPC HYPERGOL OPERATIONS

The SGOE/T Study report "51-L Work Volume Indicators", dated September 30, 1988 reveals the following SPC operational headcount.

Hypergol Maintenance Facility (Area facilities) - headcount 27.

Tasks: Operate HMF, process repair FRCS and OMS pods; certified repair facility for all hyper QDs; O&M GSE at HMF; operate ordnance lab; operate LiOH lab; perform astro arc welding for all KSC.

Pad Operations; Hypergolic Systems - headcount 42

Tasks: Maintain GSE, piping, valve complexes and pressure distribution stages for storage and transfer of hypergolic propellants at Pads A/B, including R&R of components. Provide support for servicing orbiter OMS/RCS systems and orbiter APU system.

Pad Operations quantifier - OMI S0024. Hypergol Propellant Servicing - 70 technicians

The Phase 3 addendum to Phase 2 Final Report, "51-L Work Volume Indicators", dated September 30, 1988 (page 3) shows the SPC skill mix includes 32.1% "untabulated administrative" (QA, safety, secretarial, analysts, clerks, security, business, human resources, etc.). Applying that ratio to the HMF headcount (27) and hypergol pad operations (42) yields a conservative SPC hypergol headcount of (27 + 42) x 1.32 = 91 people. This headcount is conservative because, as documented from the SPC Operations organization data, it does not include Process Engineering, Sustaining Engineering, Data Systems, LPS, Communications, Support Operations (facilities), Logistics, etc.

EG&G LIFE SUPPORT SERVICES

The hypergol impact at KSC does not end here. EG&G is the KSC contractor responsible for life support services to the SPC during hyper operations. The following data were current May 1988 and are intended to convey the complexity and impact of hypergol operations, all of which are perceived by the institutional culture as extremely hazardous.

1. The number one cost driver for self-contained atmospheric protective ensemble (SCAPE) life support is procedural and organizational response to OMRSD requirements, perceived hazards and audit trail. Any hypergol operation at KSC requires the following EG&G life support headcount as a minimum:

ACTIVE	OBSERVER
1 Supervisor	1 Safety
2 Mechanics	1 QA
2 Life Support Techs	1 Environmental Health
	2 Fire

Total - 10 heads

Note: LSOC/SPC duplicates this cadre during the hyper operation.

2. Scope of EG&G life support includes:

Pads 39A & B, OPF, HMF (OMS & RCS FACS M7-961, M7-1212), VPF (M7-1469), SAEF #2 (M7-1210), PHSF (new vert. proc. fac.), SPIF (CCAFS), SLF

Responsibilities include:
- Provision of SCAPE suits to all KSC/CCAFS user-contractor personnel except Martin Marietta/TITAN
- Procurement of all KSC propellants and gases
- Storage and delivery of hypergols to users
- Maintenance of tankers and related GSE.
- Contaminated/waste handling and disposal

3. Relevant EG&G headcount data for 12 launches (STS) per year:

HC	MISSION
7	Storage and delivery of hypergols - (cape fuel farm) and collect waste from field flush (contaminated fluids)
4	Maintain 11 ea. tankers and ~ 100 sets of transfer equipment (flex hoses, valves, connectors, etc.)
1	Supervisor for above
6	Engineers (propellants)
10	Other support (health, safety, fire, QA, etc.)
39	(about 60% of total life support group) provide SCAPE suits to LSOC/SPC - includes techs, engineers, management/supervisors (administrative and business "bureaucracy" not included).
9	Sampling and chemical analysis (all support - QA, material, etc.) cleaning and component refurb - Wiltech Corp. subcontract to EG&G.
Total 76	

4. Equipment quantities and other costs factors

EG&G has:
- ~ 150 suits - $11K ea. (current $)
- 50 liquid air backpacks - $5K each
- 11 tankers (replacement eminent '89-'92 to meet DOT requirements for rollover protection of valves and higher pressure rating)
- Hypergol scrubbers - trailer mounted are large and expensive 2 ea. trailers and 14 fixed scrubbers ~ $150K each
- Hypergol stockpile storage system (construction at CCAFS underway for existing requirements, 200K gal. fuel, 100K gal oxidizer - ~ $5M - requirement driven by USAF position relative to states enacting legislation to limit or eliminate manufacture of significant quantities of hypergols on environmental concerns. (4 year stockpile)
- Contaminated fluids disposal (Wiltech subcontract) - each scrubber contains ~ 750 gal. - $1.07/gal disposal charge each hyperload sequence.
  - / Disposal - $33K/12 launch year
  - / Alcohol flush - $10K/12 launch year
  - / Freon/N_2O_4 mix to clean oxidizer systems $2.6K/yr.

  Scrubber liquors (NaOH, citric acid) present environmental disposal problems and tail gas bubbled through NaS solution contributes to disposal problems.
  - / $38K fuel system waste (contaminated rinse waste water)
  - / Undefined cost - new fire training facility (can't just dump in pit and burn anymore)
- Design factor - Where designing hyper systems minimize (eliminate if possible) system low points. Each must have a low point drain, requiring much additional work by the "circus". EG&G presently funded $124K for design and procurement of low point drains in 1988. (about 50 or 60 ea. required)

- Potential significant cost saving: Lightweight SCAPE suits are available and used for fuel only. Umbilical hoses are used instead of backpacks, and are comfortable for long-hours of use, cost 5% of normal SCAPE price, and are 25% weight of normal SCAPE. They are not certified for oxidizer because they are rated for liquid oxidizer for only 30 minutes. These suits should be allowed for oxidizer - limitation is arbitrary and unrealistic.

5. Other headcount factors (LSOC/SPC): For 12 launches per year LSOC/SPC are forecasting a headcount of 40 each Pad A, and 40 each Pad B to support 3-shift hypergol systems and operations. Hands-on hypergol headcount support estimate for LSOC/SPC 2-pad operation is 200-to-300 people for all GSE.

Sample Concept:

Utilize portion of main propulsion for OMS. Adapt Space Station O_2/H_2 thruster for airborne/orbital RCS.

Technology Requirement:

Develop systems using prime propellants for OMS, RCS, and APU applications. (See P1.)

Technology References:

(See P1.)

Conclusions:

Contemporary launch vehicle designs require some type of OMS/RCS capability. The use of hypergols is well known and provides satisfactory propulsion performance. The full impact of hypergols on ground operations, however, is not well known by designers, and leaves much to be desired in respect to potential safety incident, schedule impact (through unquantified, repetitive area-clear events) and the basic labor-intense response to system O&M requirements. Hypergolic propellants are highly undesirable from a ground support viewpoint.

This criterion has shown at least 91 SPC persons dedicated to KSC shuttle hypergol support, and another 76 heads for life support (a total of 167 people). Utilization of a safer propellant family can potentially eliminate the external life support requirement (76) and reduce the shuttle-equivalent OMS/RCS headcount by 1/3, i.e., a potential reduction from 167 to 61 people, for a net reduction of 63%.

Theoretical simplification/enhancement of ground operations and processing schedules are unquantified herein, but are believed to be highly important. Procedures for the post-landing safeing and deservicing "camel caravan" can be much simplified and accelerated. OPF OMS/RCS/APU hyper operations, habitually scheduled for second and third shift, can also be simplified and "area clear" periods eliminated. Pad safety and countdown timeline impact can also benefit significantly by use of a safer propellant combination. In addition to the above potential safety enhancement and headcount reduction, a potential 1 to 2 day reduction in shuttle-style ground processing timeline is estimated as a potential benefit for elimination of hypergols.

No: P6 **Title**: No GN2/He On-board Purges

Operations Requirement:

Delete launch vehicle on-board GN2 and He purge systems.

Rationale:

Subject systems add weight to vehicle and electro/mechanical/pneumatics require special small O&M army and much time for ground processing and launch. In November 1985, a typical month, the SPC expended the following on propellants and gases:

GHE	@ $56.00/MSCF	5,930 MSCF		$332,100
GN2	@ 6.00/MSCF	65,000 MSCF		390,000
			TOTAL:	$722,100
LH2	@ $ 1.35/lb.	430K lb.		$580,500
LO2	@ $86.00/ton	1,910 tons		168,500
MMH	@ $ 8.00/lb.	32,480 lb.		226,600

These "cost volume indicators" reveal for designers of future vehicles that cost of purge and pressurization gases can be much larger than usually suspected. In this sample, they very nearly equal the cost of LH2 and LO2 combined! KSC Launch facilities and GSE also consume a very considerable quantity of GN2 for purges. If GN2 is readily available in large quantities to support flight hardware, a mentality to use it at any desired location unavoidably creeps in with resultant rapid escalation of commodity and systems costs.

Further quantified data are extracted from EG&G Technical Operations consumption report for processing and launch of STS-26R, launched September 29, 1988.

VEHICLE GASEOUS NITROGEN CONSUMPTION, STS-26R

EVENT		DURATION (DAYS)		USAGE (MSCF)
WCDDT	(1st attempt)	4		17,500
WCDDT	(2nd attempt)	3		19,000
FRF	(1st attempt)	4		19,000
FRF	(successful)	3		19,000
LCD		3		12,000
			Total:	86,500

Cost ($4.00/MSCF) = $346,000

Note: Normal daily usage for other C-39 facilities not included in above data.

VEHICLE GASEOUS HELIUM CONSUMPTION, STS-26R

EVENT		DURATION (DAYS)		USAGE (MSCF)
WCDDT	(1st attempt)	4		1,800
WCDDT	(2nd attempt)	3		1,900
FRF	(1st attempt)	4		2,000
FRF	(successful)	3		1,900
LCD		3		900
			Total:	8,500

Cost (64.00/MSCF) = $544,000

Note: Normal daily usage for other C-39 facilities not included in above.

The above STS-26R costs were calculated from the KSC contractor commodities price list circa May 1988. The following are extracted from that list.

GHE	@	\$64.00/MSCF
GN2	@	\$ 4.00/MSCF
LH2	@	\$ 1.62/lb.
LO2	@	\$55.00/ton
MMH	@	\$10.00/lb.
N_2H_4	@	\$10.00/lb.

Note: LO2 (fuel cell grade) is \$264.00/ton

Sample Concept:

Eliminate sources of hazardous fluid leaks (and consequently purges) such as bolted flanges with seals, flared fittings, etc. Utilize welded or brazed assembly techniques and/or Nitinol compression fittings.

Design vehicle with multitude of small, lightweight, inexpensive electronic fuel and oxidizer sensors capable of verifying leak-tight vehicle configuration. Best of all: use innovative concepts to devise systems that do not require inert purges or pressurizations. Shuttle expends hundreds of manhours per flow in manual use of mass spec for leak detection at all welds and plumbing fittings. Load fuel first. Verify system leak-free, then load oxidizer.

Technology Requirement:

- o Develop MPS engine requiring no purge prior to firing in atmosphere.
- o Develop MPS engine requiring no propellant tank pre- pressurization.
- o Lightweight, low cost mass spectrometer for launch and flight environment.
- o Consider Nitinol fittings, particularly for hard-to-reach connections.

Technology References:

NASA/RECON (abstracts attached):

86X71562, 86N21849, 85X76796, 85X76476, 85X73181, 85N21386, 85A47011, 84K10941, 84A42759, 82X78166

Conclusions:

Innovative reduction of vehicle inert purges and pressurizations can potentially reduce cost of inert gases up to \$.9 million/flow.

Innovative elimination of "normal" purge and pressurization systems will lead to a grossly simpler vehicle, requiring greatly reduced ground processing GSE, headcount, and time.

86X71562 CATEGORY 35 RPT#: AD-B995180 LS85-14 CNT#: N00024-85-C-5301 85/08/00 39 PAGES UNCLASSIFIED DOCUMENT NASA PERS. ONLY

UTTL: Liquid propellant leak detectors. A bibliography TLSP: Report, 1 Jan. 1969 - 30 Apr. 1985

AUTH: A/POPPE, S. L.

CORP: Johns Hopkins Univ., Silver Spring, Md. CSS: (Chemical Propulsion Information Agency.)

SAP: Limited by ITAR MFC: 00

CIO: UNITED STATES

MAJS: / *BIBLIOGRAPHIES/ *CHEMILUMINESCENCE/ *GAS DETECTORS/ *LEAKAGE/ *LIQUID ROCKET PROPELLANTS / *TOXIC HAZARDS

MINS: / HEAT MEASUREMENT/ SPECTROSCOPY/ THIN FILMS

....

86N21849# ISSUE 12 PAGE 1953 CATEGORY 36 RPT#: PB86-102811 GRI-85/0140 CNT#: GRI-5084-260-0998 85/06/00 39 PAGES UNCLASSIFIED DOCUMENT

UTTL: Semiconductor laser source for natural gas leak detection TLSP: Final Report, 1 Sep. 1984 - 31 Mar. 1985

AUTH: A/ELLIOTT, R. A.

CORP: Oregon Graduate Center for Study and Research, Beaverton. AVAIL.NTIS

SAP: HC A03/MF A01

CIO: UNITED STATES

MAJS: / *ABSORPTION SPECTRA/ *GAS DETECTORS/ *LEAKAGE/ *NATURAL GAS/ *SEMICONDUCTOR LASERS

MINS: / DIFFERENTIAL CALCULUS/ ETHANE/ GALLIUM ARSENIDE LASERS/ HYDROCARBONS/ METHANE

ABA: GRA

ABS: The feasibility of using semiconductor lasers as infrared sources for handheld natural gas leak detectors was assessed. The detection system was assumed to be based on the differential absorption (DIAL) technique and to operate at ambient temperatures. The absorption spectra of the major components of natural gas, methane and ethane, were measured in the spectral range from 1.2 to 2.0 micrometers where cryogenic cooling of detectors is not required. Both spectra exhibited absorption features due to overtones of the fundamental C-H stretching modes strong enough to be suitable for DIAL measurements. It is found that lasers made from InGaAs emitting near 1.65 micrometers are suitable for methane detection however, considerable materials development would be needed to develop a laser for ethane detection.

....

85X76796# CATEGORY 33 RPT#: AD-B091752L DREP-CR-84-3 83/04/00 40 PAGES UNCLASSIFIED DOCUMENT US GOV AGENCIES

UTTL: Development of prototypes of a coated piezoelectric quartz crystal device for the detection of airborne vapors

AUTH: A/TURNHAM, B. D.

CORP: Defence Research Establishment Pacific, Victoria (British Columbia).

CIO: CANADA

MAJS: / *DETECTION/ *PIEZOELECTRIC CRYSTALS/ *PROTOTYPES/ *QUARTZ CRYSTALS/ *VAPORS

MINS: /COATINGS/ GAS DETECTORS/ GREASES/ OTTO CYCLE/ QUARTZ/ SILICONES/ SOLVENTS

....

85X76476# CATEGORY 54 RPT#: AD-B091959L AD-E001640 NATC-SY-37R-84 85/04/11 16 PAGES UNCLASSIFIED DOCUMENT US GOV AGENCIES

UTTL: Evaluation of gas detector sets for aircraft bleed air analysis

TLSP: Final Technical Report

AUTH: A/ABELL, C.

CORP: Naval Air Test Center, Patuxent River, Md.

CIO: UNITED STATES

MAJS: / *AIR POLLUTION/ *AIR QUALITY/ *CONTAMINANTS/ *ENGINE ANALYZERS/ *FLIGHT CREWS / *GAS DETECTORS/ *HYDROCARBONS

MINS: / AIRCRAFT COMPARTMENTS/ AIRCRAFT ENGINES/ ALKANES/ CALIBRATING/ COCKPITS/ DEFLECTION/ ELUTION/ GAS ANALYSIS/ GAS CHROMATOGRAPHY/ GAS MIXTURES/ INSTALLING/ IRRITATION/ LEVEL (QUANTITY)/ PORTABLE EQUIPMENT/ PYROLYSIS/ REMOVAL

....

85X73181 CATEGORY 14 84/08/00 8 PAGES UNCLASSIFIED DOCUMENT US GOV AGENCIES

UTTL: History, design and performance of the Space Shuttle hazardous gas detection system

AUTH: A/HELMS, W. R.

CORP: National Aeronautics and Space Administration. John F. Kennedy Space Center, Lompoc, Calif.

SAP: Limited by ITAR In APL The 1984 JANNAF Safety and Environ. Protec. Subcomm. Meeting p 195-202 (SEE X85-73167 10-28)

CIO: UNITED STATES

MAJS: / *GAS DETECTORS/ *SPACE SHUTTLES/ *TOXIC HAZARDS/ *WARNING SYSTEMS

MINS: /ACCURACY/ CRYOGENIC ROCKET PROPELLANTS/ DESIGN ANALYSIS/ HISTORIES/ LEAKAGE

....

85N21386# ISSUE 12 PAGE 1815 CATEGORY 27 RPT#: PB85-113124 CRA-684-VOL-5 NBS/GCR-84/470/5-VOL-5 FR-19 CNT#: NB82-SBCA-1637 84/08/00 6 VOLS 67 PAGES UNCLASSIFIED DOCUMENT

UTTL: Technological and economic assessment of advanced ceramic materials. Volume 5: A case study of ceramic toxic and combustible gas sensors TLSP: Final Planning Report CORP: Charles River Associates, Inc., Boston, Mass. AVAIL.NTIS SAP: HC A04/MF A01

CIO: UNITED STATES

MAJS: / *CERAMICS/ *ECONOMIC IMPACT/ *GAS DETECTORS/ *INDUSTRIES/ *MANUFACTURING/ *TECHNOLOGY ASSESSMENT

MINS: / FLAMMABILITY/ NEGATIVE RESISTANCE DEVICES/ PIEZOELECTRICITY/ THERMISTORS / TOXICITY

ABA: GRA

ABS: An overview of ceramic sensors is provided. Ceramic gas sensor technology is discussed as well as the world ceramic industry and the potential economic impacts of technological change.

....

85A47011 ISSUE 22 PAGE 3292 CATEGORY 38 CNT#: W-7405-ENG-82 84/00/00 7 PAGES UNCLASSIFIED DOCUMENT

UTTL: Inference of compressive stresses at joined interfaces using ultrasonic reflectivity

AUTH: A/THOMPSON, D. O.; B/REHBEIN, D. K.; C/SKILLINGS, B. J.; D/SMITH, J. F. PAA: D/(DOE, Ames Laboratory, Ames, IA)

CIO: UNITED STATES; IN: Nondestructive methods for material property determination; Proceedings of the Symposium, Hershey, PA, April 6-8, 1983 (A85-47001 22-38). New York, Plenum Press, 1984, p. 171-177.

MAJS: / *COMPRESSION LOADS/ *FASTENERS/ *JOINTS (JUNCTIONS)/ *NITINOL ALLOYS/ *STRESS ANALYSIS/ *ULTRASONIC TESTS

MINS: / NICKEL ALLOYS/ REFLECTANCE/ SHAPE MEMORY ALLOYS/ SOLID-SOLID INTERFACES

ABA: G.R.

ABS: A problem of considerable interest is related to the nondestructive determination of the compressive component of stress in various kinds of interference fasteners. The usual techniques employed for stress measurements are not suited for the considered case. The present paper is concerned with results which were obtained in a study of Nitinol couplers by means of a procedure utilizing ultrasonic reflectivity and suitable interpretive concepts. Nitinol, a nickel-titanium alloy, is a shape memory material which undergoes a rather special type of martensitic transformation. The Nitinol fastener is a short, thick-walled hollow cylinder. Attention is given to aspects of sample preparation and stress characterization, ultrasonic measurements, and experimental results and interpretation.

....

84K10941 (MOD-000) CNT#: NAS10-10916; SBIR-22.01-4770 DUN#: 047627732 CIC#: 1384155 National Aeronautics and Space Administration. John F. Kennedy Space Center, Lompoc, Calif. Spectral Sciences, Inc., Burlington, Mass.

UTTL: Hydrogen/oxygen concentration monitor UNCLASSIFIED OCTOBER 28, 1983 / APRIL 28, 1984

PI: B/GERSH, M. REPORT STATUS UNAVAILABLE Incomplete processing

MAJS: / *ELECTRON CAPTURE/ *GAS ANALYSIS/ *GAS CHROMATOGRAPHY/ *GAS DETECTORS/ * HYDROGEN/ *MASS SPECTROMETERS/ *MONITORS/ *OXYGEN/ *PRELAUNCH TESTS/ *SPACE SHUTTLES

....

84A42759 ISSUE 21 PAGE 3019 CATEGORY 26 83/00/00 12 PAGES UNCLASSIFIED DOCUMENT

UTTL: The use of shape memory effect alloys as an engineering material

AUTH: A/BENSON, R. W.; B/FLOT, R. F.; C/SANDBERG, C. L. PAA: C/(Raychem Corp., Menlo Park, CA)

CIO: UNITED STATES; IN: National Technical Conference, 15th, Cincinnati, OH, October 4-6, 1983, Proceedings (A84-42726 21-23). Azusa, CA, Society for the Advancement of Material and Process Engineering, 1983, p. 403-414.

MAJS: / *NICKEL ALLOYS/ *NITINOL ALLOYS/ *PHASE TRANSFORMATIONS/ *SHAPE MEMORY ALLOYS/ *TITANIUM ALLOYS

MINS: / ACTUATORS/ BODY CENTERED CUBIC LATTICES/ ELECTRIC CONNECTORS/ PIPES (TUBES)/ UTILIZATION

ABA: Author

ABS: The unique shape memory properties of nickel-titanium make it useful as an engineering material in many areas. Nitinol, as it is usually referred to, was discovered in the early 1960s. Shape memory effect alloys for commercial use are being developed in the following product areas: (1) pipe and tube joining systems, (2) electrical connectors, and (3) electromechanical actuators. This paper describes the metallurgical phenomenon of the martensitic to austenitic structural change and then concentrates on the practical application of this phenomenon in the aforementioned product areas.

....

82X78166# CATEGORY 35 RPT#: AD-B065813L MRC-DA-992 AFWAL-TR-80-2089 CNT#: F33615-78-C-2023 AF PROJ. 3048 82/05/00 54 PAGES UNCLASSIFIED DOCUMENT US GOV AGENCIES

UTTL: Performance characterization of combustible gas monitors used for military aviation and missile fuels TLSP: Final Report, Oct. 1979 - Mar. 1980

AUTH: A/PARTS, L.; B/BUCHER, T. J.

CORP: Monsanto Research Corp., Dayton, Ohio.

CIO: UNITED STATES; Wright-Patterson AFB, Ohio AFWAL

MAJS: / *AIRCRAFT FUELS/ *FLAMMABLE GASES/ *GAS DETECTORS/ *ROCKET PROPELLANTS/ * WARNING SYSTEMS

MINS: / GAS IONIZATION/ MILITARY AIRCRAFT/ SAFETY FACTORS

....

No: P7 **Title:** No GN_2/H_e Pressure Systems

Operations Requirement:

Delete GN2 and He valves control plumbing and propellant tankage pressure systems.

Rationale:

Elimination of GN2 and He storage bottles, supply valves, manifolds, plumbing, and multiple test and checkout, will significantly lighten the vehicle, and simplify and speed-up ground support operations.

See criteria item P6 for gas quantities and costs for STS-26R.

Sample Concept:

Provide electromechanical valve actuators with electrical self-test/status capability. Propellant tank prepressurization at launch provided from cryo propellant boil-off with vent valve cycling as needed. Use gas generator or engine hot gas bleed/heat exchanger during flight a la STS.

See criteria item P6 for specific data on gas quantities and costs.

Technology Requirement:

Design application of existing technology. Innovative vehicle design.

Technology References:

This criteria item P6 for related references.

No.: P8 **Title:** No Gimballed Engines

Operations Requirement:

Devise thrust vector or vehicle attitude control system which eliminates need for gimballed engines and associated hydraulics, seals, pivots, bellows, etc.

Rationale:

Gimbal systems are expensive and heavy, and add a severe burden of O&M, and test and checkout to ground support operations.

Sample Concept:

Using multi-engine concept, and off-center thrust vectors, use differential throttling for trajectory control. Accept less than "normal" TVC angle specifications. Reexamine the flight dynamics models to determine if the TVC requirements can be reduced to a point where methods other than gimballing would be acceptable.

Technology Requirement:

Throttleable engines; see Items P1.1 and P1.3 TVC concepts.

Technology References:

See P1.3.

No.: P9 **Title:** No Extensive Recovery & Refurbishment

Operational Requirement:

Eliminate crash and salvage operations similar to STS SRB. Any land recovery should be benign and easily transportable.

Rationale:

Experience with the STS SRB's has proven it is not cost effective. Any water recovery with propulsion/avionics units would be even worse.

Size and weight of recovery module dictate firm landing site with good road access. A typical module of 50,000 pounds, the size of a small two-story house, presents a severe transportation problem.

Environmental problems also exist with residual hypergols onboard with land recovery.

Sample Concept:

Expendable or runway recovery rather than parachute type recovery.

Technology Requirement:

Simple integrated propulsion system design that can be built cheaply enough to be expendable. (See P1).

Technology References:

See P1.

L1 **Title: 100% Computer Connectivity**

Operations Requirement:

All computers associated in any manner with operations, flight, or ground must provide and maintain complete connecting (bridging).

Rationale:

The vast amount of data required to support and maintain any operational system requires maintenance of maximum efficiency.

Paperwork currently requires a large portion of the allocated operation budget. A potential reduction of approximately 30% of ground operations cost can be achieved by automation of paperwork.

TYPICAL STS PAPERWORK PER FLOW

	AVG. NO. PER FLOW	AVG. REV. PER FLOW	AVG. PGS. PER DOC.	TOTAL PAGES	AVG. NO. COPIES	TOTAL DIST. PAGES
Flight OMIs	513	195	210	148,680	95	14,124,600
Facility O&M OMIs	215	N/A	43	9,245	25	231,125
Job Cards	682	628	7	9,170	35	320,950
Problem Reports	1,250	N/A	15	18,750	N/A	18,750
Test Preparation Sheets	339	N/A	46	15,594	N/A	15,594
Totals:	2,999	823	321	*201,439	155	14,711,019
Plus Scrub Turnaround:						4,300
						14,715,319

* New paper cost is $1,200 per page; electronic is $600.
Update paper cost is $200-300 per page; electronic is $100-150.

Sample Concept:

Utilization of commercial DBMS which support heterogenous file transfer and data import and export via MIL-STD-1840A.

Technologies References:

NASA/RECON:
86N27948, 84N31144, 84N23296, 84N21107

DIALOG: 2034798, 2011582, 2011580, 1979702, 1978939, 1964804, 1947009, 1877817, 1876159, 1868213, 1852081, 1842967, 1836336, 1823013, 1380555

PAGE 248 INTENTIONALLY BLANK

86N27948# ISSUE 18 PAGE 2964 CATEGORY 62 RPT#: IS-23-003-REV ESA-CR(P)-2121-REV CNT#: ESTEC-6017/84-NL-BI SESA-2066-S 85/06/08 82 PAGES UNCLASSIFIED DOCUMENT Revised

UTTL: Advanced data system interconnection study

TLSP: Final Report

CORP: Sistemi di Teleinformatica ed Automazione, Rome (Italy).; MATRA Espace, Toulouse (France). AVAIL.NTIS

SAP: HC A05/MF A01

CIO: ITALY; Paris, France ESA Prepared in cooperation with MATRA Espace, Toulouse, France

MAJS: /*ARCHITECTURE (COMPUTERS)/ *COMPUTER SYSTEMS DESIGN/ *DATA MANAGEMENT/ *DESIGN ANALYSIS/ *FUNCTIONAL DESIGN SPECIFICATIONS/ *ONBOARD DATA PROCESSING / *ONBOARD EQUIPMENT

MINS: /AIRBORNE/SPACEBORNE COMPUTERS/ COMMUNICATION NETWORKS/ SYSTEMS ENGINEERING/ USER REQUIREMENTS

ABA: Author (ESA)

ABS: Onboard data management system requirements were reviewed. The study includes the identification of the services to be provided to the end users~~, the analysis of the data~~ communication network architectures, and the design of the data system specification according to space environment constraints. The logical approach and the three axis matrix analysis prove to be well suited with regard to result validation processes. The r include the distribution of communication services into architectural layers, a definition of interfaces with the physical supports, and a mapping of architectural layers into physical equipment. The study is considered a basic step for the functional specifications toward the implementation of the communication architecture.

....

84N31144# ISSUE 21 PAGE 3332 CATEGORY 15 RPT#: AD-P003540 82/11/00 10 PAGES UNCLASSIFIED DOCUMENT

UTTL: Application of 1553B to MRASM (Medium Range Air to Surface Missile): A systems look

AUTH: A/LEIB, J. E.

CORP: General Dynamics Corp., San Diego, Calif. AVAIL.NTIS

SAP: HC A25/MF A01 In ASD Proc. Papers of the 2nd AFSC Avionics Standardization Conf., Vol. 1 p 295-304 (SEE N84-31121 21-06)

CIO: UNITED STATES

MAJS: /*AIR TO SURFACE MISSILES/ *BUS CONDUCTORS/ *INFORMATION TRANSFER

MINS: / COMPUTERS/ DATA TRANSFER (COMPUTERS)/ STANDARDS/ SYSTEMS ENGINEERING/ UTILIZATION

ABA: Author (GRA)

ABS: MRASM (Medium Range Air to Surface Missile) is the first missile to incorporate a MIL-STD-1553B data bus as the primary means of data transfer among the elements of the missile. The standard, built around applications which could dedicate major computing power to manage the affairs of the data bus, posed a challenge to MRASM because this bus management function needed to be performed on the input/output card which fit in an existing computer design, while not utilizing its host computer on a continuing basis. This paper reviews the process by which the data bus operation was defined, describes the protocol adopted for timely transfer of data, and argues the case for the system design decisions.

....

84N23296# ISSUE 13 PAGE 2050 CATEGORY 81 RPT#: AD-P002749 83/00/00 5 PAGES UNCLASSIFIED DOCUMENT

UTTL: Paperless solicitation and contracting

TLSP: Final Report

AUTH: A/NICKOLAS, G. T.

CORP: Army Armament Munitions and Chemical Command, Rock Island, Ill. AVAIL.NTIS

SAP: HC A24/MF A01 In AF Business Research Management Center Proc. of the Fed. Acquisition Res. Symp. with Theme p 12-16 (SEE N84-23293 13-81)

CIO: UNITED STATES

MAJS: /*COMMUNICATION NETWORKS/ COMPUTER TECHNIQUES/ *GOVERNMENT PROCUREMENT/ * MANAGEMENT PLANNING

MINS: /AUTOMATION/ COMPUTERS/ CONTRACTS/ TECHNOLOGICAL FORECASTING

ABA: Author (GRA)

ABS: This paper examines the contract simplification effort currently undergoing prototype development in the services under the Defense Acquisition Improvement Program. This effort has led the author to explore the state of the art of contracting and what changes will have to be made to methods of contracting to keep pace with the commercial marketplace in the next decade. Further, the computer is becoming as common as the telephone in every office. The use of the computer seems to be unlimited, ranging from games to sending electronic mail. This paper provides what the author perceives as a step by step advancement needed by the Government in the use of computers to transition from paper contracts transported by mail to paperless contracting transmitted via telephone line or satellite to contractors and between contractor and Government agencies. This paper explains the author's concept of the various elements of paperless contract evolution which must be achieved to allow the release of solicitations via computers, and the eventual award of contracts via computers.

....

84N21107# ISSUE 11 PAGE 1704 CATEGORY 60 RPT#: AD-A137688 RADC-TR-83-107-VOL-3 CNT#: F30602-81-C-0142 AF PROJ. 5581 83/06/00 351 PAGES UNCLASSIFIED DOCUMENT

UTTL: Distributed processing tools definition. Volume 3: An integrated software engineering environment for distributed processing software development

TLSP: Final Technical Report, Jun. 1981 - Jan. 1983

AUTH: A/CONN, H. C., JR.; B/KELLOGG, D. L.; C/NELSON, S. L.; D/HARMON, S. L.; E/JOHNSON, S. A.

CORP: General Dynamics Corp., Fort Worth, Tex. CSS: (Data Systems Div.) AVAIL.NTIS

SAP: HC A16/MF A01

CIO: UNITED STATES; Griffiss AFB, N.Y. RADC

MAJS: /*COMPUTER PROGRAMS/ *COMPUTERS/ *DISTRIBUTED PROCESSING/ *SYSTEMS INTEGRATION

MINS: / ARCHITECTURE (COMPUTERS)/ COMMAND AND CONTROL/ COMMUNICATION NETWORKS/ COMPUTER PROGRAMMING/ DATA BASES/ KERNEL FUNCTIONS/ LIFE (DURABILITY)/ MESSAGE PROCESSING/ MILITARY TECHNOLOGY/ REQUIREMENTS/ SPECIFICATIONS/ SYSTEMS ENGINEERING/ TECHNOLOGY ASSESSMENT/ WEAPON SYSTEMS

ABA: GRA

ABS: The objective of this three-phase effort is to identify the hardware/software technology pertinent to the implementation of tightly-coupled embedded distributed systems for DoD applications, establish an integrated approach regarding the total life-cycle software development period with correlation as to the applicability of existing/near-term software engineering methodology, techniques and tools to each life-cycle phase, and define the functional design requirements pertinent to the far-term development of needed software engineering methodology, techniques and tools. A product of this effort is the recommended design of a system support environment encompassing the integrated implementation of candidate software engineering tools.

....

2034798 C88002658; A recognition algorithm of dashed and chained lines for automatic inputting of drawings Shimada, S.; Kakumoto, S.; Ejiri, M. Central Res. Lab., Hitachi Ltd., Kokubunji, Japan Syst. Comput. Japan (USA) vol.18, no.6 25-37 June 1987

CODEN: SCJAEP

ISSN: 0882-1666

Treatment: PRACTICAL

Document_Type: JOURNAL PAPER

Languages: ENGLISH (11 Refs); Recognition of lines in drawings is a major task in automatic data acquisition for CAD (computer-aided design). This paper proposes an algorithm for the recognition of dashed and chained lines in graphical images. This algorithm consists of two major steps: the local recognition step which extracts local connectivity of line segments, and the global recognition step which performs route finding of connected segments based on syntax. The syntax is usually specific to each type of drawing, and is represented as rules. The performance of the proposed algorithm is demonstrated based on experiments using LSI cell drawings and topographical maps containing dashed and chained lines as graphical components.

Descriptors: CAD; computer graphics; computerised pattern recognition

Identifiers: LINE RECOGNITION; DASHED LINES; CAD; AUTOMATIC DRAWING INPUT ; RECOGNITION ALGORITHM; CHAINED LINES; DRAWINGS; GRAPHICAL IMAGES; LOCAL CONNECTIVITY; ROUTE FINDING; SYNTAX; LSI CELL DRAWINGS; TOPOGRAPHICAL MAPS

Class_Codes: C5530; C5260; C6130B; C7400

....

2011582 C87065561; IBM has new products for better managing of voice/data networks; Office (USA) vol.106, no.2 40 Aug. 1987

CODEN: OFISAD

ISSN: 0030-0128

Treatment: GENERAL, REVIEW

Document_Type: JOURNAL PAPER

Languages: ENGLISH; A family of products that will enable customers to better manage and connect its and other manufacturers' communications equipment has been announced by International Business Machines Corp. The key elements include voice and data applications, bandwidth management, enhanced network management, and increased support for international connectivity standards.

Descriptors: COMPUTER NETWORKS; DATA COMMUNICATION EQUIPMENT; IBM COMPUTERS; VOICE COMMUNICATION

Identifiers: IBM; VOICE/DATA NETWORKS; BANDWIDTH MANAGEMENT; NETWORK MANAGEMENT; INTERNATIONAL CONNECTIVITY STANDARDS

Class_Codes: C5620

....

2011580 D87002971; Connectivity! Buzzword: fact or fiction; Dzubeck, F.X. Adm. Manage. (USA) vol.48, no.8 36-8 Aug. 1987

CODEN: ADMAAF ISSN: 0884-5905

Treatment: GENERAL,REVIEW;

Document_Type: JOURNAL PAPER

Languages: ENGLISH; In today's active world of communications, one word seems to be occurring more and more-connectivity. In the world of data, this means computers communicating with computers, programs with programs, and end users with end users. There are several steps which can be taken to address the connectivity issue: establish a goal for a limited set of vendors; establish a set of inviolate standards; assure transparency to the end user; force all network addressing to be logically global; allow file techniques such as virtual file/disk storage and global file addressing to be end-user accessible; establish global routing for all network traffic; distribute network control and monitoring systems; use off-the-shelf hardware; and involve the end user, network designer and management in the connectivity decision making process.

Descriptors: INTER-COMPUTER links

Identifiers: INTER-COMPUTER COMMUNICATION; NETWORK MONITORING; CONNECTIVITY; STANDARDS; FILE TECHNIQUES; GLOBAL ROUTING; NETWORK TRAFFIC; NETWORK CONTROL; HARDWARE

Class_Codes: D5020

....

1979702 B87062594, C87054118; IBM's advanced communications architectures Doyle, L.W. Int. Data Corp., Framingham, MA, USA Bus. Commun. Rev. (USA) vol.17, no.2 26-31 March-April 1987

CODEN: BCOREDD

ISSN: 0162-3885 U. S. Copyright Clearance Center Code: 0162-3885/87/$0+.50

Treatment: GENERAL,REVIEW;

Document_Type: JOURNAL PAPER

Languages: ENGLISH; Discusses the trend towards multivendor integration and how large organizations can utilize IBM's advanced communications protocols for electronic mail, document exchange, data file exchange, and micro-mainframe applications. IBM is promoting its SNA-Systems Network Architecture-and its associated protocols as the common language for multivendor communications. But a critical question has been whether IBM's major competitors and other third-parties would support the SNA-based architecture. For now the answer appears to be that they will. Despite reservations, Digital Equipment, Harris, Wang, Hewlett-Packard, Data General and smaller third-party vendors are providing links between their office systems and IBM hosts running DISOSS; and during 1987, other office vendors are expected to conform to SNA and its related architectures. Conformance to IBM protocols may, in the future, allow dissimilar equipment to exchange documents and electronic mail with or without connections to SNA and IBM equipment. While SNA and IBM's electronic mail protocols have been successful in garnering third-party support, IBM's newest architectures, Enhanced Connectivity Facility (ECF) and Distributed Data Management (DDM), have only limited application and vendor support. However, over time these protocols will also pick up support from third party software and hardware vendors.

Descriptors: COMPUTER NETWORKS; PROTOCOLS

Identifiers: COMPUTER NETWORKS; COMMUNICATIONS ARCHITECTURES; COMMUNICATIONS PROTOCOLS; ELECTRONIC MAIL; DOCUMENT EXCHANGE; DATA FILE EXCHANGE; MICRO-MAINFRAME APPLICATIONS; IBM; SNA; SYSTEMS NETWORK ARCHITECTURE; DIGITAL EQUIPMENT; HARRIS; WANG; HEWLETT-PACKARD; DATA GENERAL; DISOSS; ENHANCED CONNECTIVITY FACILITY; DISTRIBUTED DATA MANAGEMENT

Class_Codes: B6210L; C5620

....

1978939 B87059071, C87055817; Hierarchical-level CAE system features snap and simplicity Mladejovsky, M. Hewlett-Packard Salt Lake Cericor Oper., UT, USA Electron. Des. (USA) vol.35, no.4 113-16 19 Feb. 1987

CODEN: ELODAW ISSN: 0013-4872

Treatment: PRACTICAL; PRODUCT REVIEW

Document_Type: JOURNAL PAPER

Languages: ENGLISH; Electronic Design System, a CAE tool for designing printed circuit boards, custom VLSI circuits and ASICs is built around an innovative data-base technology. It lets an engineer enter schematics interactively, simulate circuit designs, create parts libraries, check electrical design rules and specify critical design requirements. A user can interactively check connectivity, specify simulation stimuli and assign physical references. The designautomation system includes an easy-to-learn work environment which simplifies interaction with a computer. Among its helpful features are icons, multiple windows, pop-up context-specific menus and a consistent graphics editor.

Descriptors: CIRCUIT ANALYSIS COMPUTING; CIRCUIT LAYOUT CAD

Identifiers: HEWLETT PACKARD; USER INTERFACE; ELECTRONIC DESIGN SYSTEM; CAE TOOL; PRINTED CIRCUIT BOARDS; CUSTOM VLSI CIRCUITS; ASICS; DATA-BASE TECHNOLOGY; DESIGN-AUTOMATION SYSTEM

Class_Codes: B1130B; C7410D

....

1964804 B87055548; Multivendor network realization through ISDN Ibrahim, H.; Morgan, K.; Taylor, P.; Verma, P. Adv. Micro Devices, Inc., Sunnyvale, CA, USA; Kuehn, P.J. (Editors)

Sponsor: Int. Council Comput. Commun; New Communication Services: A Challenge to Computer Technology. Proceedings of the Eighth International Conference on Computer Communication 413-16 1986 15-19 Sept. 1986 Munich, Germany

Publ: North-Holland, Amsterdam, Netherlands xv+783 pp. ISBN 0 444 70060 9

Treatment: PRACTICAL

Document Type: CONFERENCE PAPER

Languages: ENGLISH (4 Refs); The integrated services digital network (ISDN) an evolving standard for end-to-end digital connectivity and services, is expected to have a major impact on the realization of multivendor systems and networks. The authors first describe present telecommunications and data processing environments. Users' needs for a multivendor integrated network in this environment are discussed. After briefly summarizing ISDN, the authors show how ISDN fulfills these needs. Finally they discuss activities that will lead to the success of ISDN. These activities include initial ISDN implementation through the digital multiplexed interface DMI and incorporation of ISDN in VLSI devices.

Descriptors: ISDN

Identifiers: USER NEEDS; ISDN; MULTIVENDOR SYSTEMS; NETWORKS; TELECOMMUNICATIONS; DATA PROCESSING; INTEGRATED NETWORK; DIGITAL MULTIPLEXED INTERFACE; DMI; VLSI DEVICES

Class_Codes: B6210; B6230F

....

1947009 C87048125, D87002195; LANS: bringing information tools together Mod. Off. Technol. (USA) vol.3,, no.5 BC14-21 May 1987

CODEN: MOFTDB ISSN: 0026-8208

Treatment: GENERAL, REVIEW; PRACTICAL;

Document_Type: JOURNAL PAPER

Languages: ENGLISH Local area networking-or, at least the underlying concept, sharing information and resources-is an idea that has been around almost as long as computers. Today, growing integration of computer technology calls for a data communications capability equal to that of the voice networking taken for granted in the telephone network. When the Integrated Services Data Network (ISDN) is fully implemented (it's being tested in several places this year), it will provide the same universal access to human and machine based sources of information that is now expected on the phone. Even as new

technologies develop, LAN vendors are still trying to come to grips with connectivity: creating an integrated network with hardware and software from diverse vendors. Standardization or compatibility, among different devices and also different networking technologies is still at the forefront of concerns of information managers. The LAN industry is forecast to increase by another 20 to 30 percent this year, and again in 1988 when prices are expected to drop.

Descriptors: LOCAL AREA NETWORKS

Identifiers: LANS; LOCAL AREA NETWORKING; STANDARDIZATION; INFORMATION TOOLS; INTEGRATION; COMPUTER TECHNOLOGY; DATA COMMUNICATIONS; VOICE NETWORKING; INTEGRATED SERVICES DATA NETWORK; ISDN; COMPATIBILITY

Class_Codes: C5620L; D5020

....

1877817 B87028175, C87023292; Open systems for factory communications Kochar, V.

Sponsor: Intel Int; ISATA 86 Proceedings. 15th International Symposium on Automotive Technology and Automation with Particular Reference to Computer Integrated Manufacture ISATA 86024/15 6-10 Oct. 1986 Flims, Switzerland

Publ: Automotive Autom. (1984), Croydon, England 3 vol. (i+114+v+736+v+726) pp. ISBN 0 947719 06 7

Treatment: PRACTICAL

Document Type: CONFERENCE PAPER

Languages: ENGLISH; The Manufacturing Automation Protocol (MAP) has rapidly become he most talked about standard for multi-vendor communications in the factory. MAP, based on a local area networking philosophy, enables transfer of large amounts of data between intelligent machines. On the factory floor, however, there exists a need for a fast, reliable, low-cost communications standard that is easy to use. BITBUS is a sensor-actuator level interconnect scheme designed specifically to address the needs of such high-performance, cost-sensitive applications. This article outlines the specification of these two complementary standards and describes a set of OEM modules available to manufacturers required to provide open systems connectivity in their product offerings.

Descriptors: DATA COMMUNICATION SYSTEMS; FACTORY AUTOMATION; LOCAL AREA NETWORKS; PROTOCOLS; STANDARDS

Identifiers: OSI; FACTORY COMMUNICATIONS; MANUFACTURING AUTOMATION PROTOCOL; MAP; LOCAL AREA NETWORKING; COMMUNICATIONS STANDARD; BITBUS; SENSOR-ACTUATOR LEVEL INTERCONNECT SCHEME; OEM MODULES; OPEN SYSTEMS CONNECTIVITY

Class_Codes: B6210L; C5620L; C7420

....

1876159 B8702814,, C87023262; RMCNET: a local area network of multiple connectivity Rahman, M.H.; Desgroseilliers, J.L.; Wilson, J.D. Dept. of Electr. Eng., R. Mil. Coll. of Canada, Kingston, Ont., Canada

Sponsor: IEEE; IEEE ELECTRONICOM '85. Conference Proceedings (Cat. No.85CH2238-4) 64-7 vol.1 1985; 7-9 Oct. 1985 Toronto, Ont., Canada

Publ: IEEE, New York, USA 3 vol. 675 pp. U. S. Copyright Clearance Center Code: 85CH2238- 4/0064$01.00

Treatment: EXPERIMENTAL; Document Type: CONFERENCE PAPER

Languages: ENGLISH (12 Refs); RMCNET-K is a local area network of connectivity K (K=3 or 4). It has a regular structure and uses the minimum number of links to obtain the required connectivity. The topologies of these networks are presented. A protocol has been defined for the network to enable the transfer of data in an organized fashion. The protocol uses three types of packets. A preliminary design is also presented of a node for RMCNET-3. These networks were simulated on a Honeywell computer to obtain their throughput and delay. Results of the simulations are presented.

Descriptors: FAULT TOLERANT COMPUTING; LOCAL AREA NETWORKS; NETWORK TOPOLOGY; PACKET SWITCHING; PROTOCOLS

Identifiers: SURVIVABLE LAN TOPOLOGIES; NODE DESIGN; RMONET; LOCAL AREA NETWORK OF MULTIPLE CONNECTIVITY; REGULAR STRUCTURE; MINIMUM NUMBER OF LINKS; PROTOCOL; PRELIMINARY DESIGN; THROUGHPUT; DELAY

Class_Codes: B6210L; B1110; B6150; C5620L

....

1868213 B87028135, C87023136, D87001220; Trends in communications networks: what's real and what's not Colony, G.; Words (USA) vol.15, no.4 12-17 Dec. 1986-Jan. 1987

CODEN: WRDSIR

ISSN: 0164-4742

Treatment: PRACTICAL

Document_Type: JOURNAL PAPER

Languages: ENGLISH; The trends in integration and networking include the concept of departmental computing, or the departmental resource processor. Departmental computing is the idea that, between the personal computer and the mainframe in a large corporation, there will be a departmental system acting as an integrator for personal computers. To attain a true multivendor environment, communications bridges between different types of office systems, different protocols and different local area networks are required. The IBM token ring and the IBM PC network in the general environment of local area networks in large corporations are important new developments. In addition, IBM connectivity is a growth area.

Descriptors: COMPUTER NETWORKS; DATA COMMUNICATION SYSTEMS; INTER-COMPUTER LINKS

Identifiers: COMMUNICATIONS NETWORKS; NETWORKING; DEPARTMENTAL COMPUTING; DEPARTMENTAL RESOURCE PROCESSOR; PERSONAL COMPUTER; MAINFRAME; MULTIVENDOR ENVIRONMENT; COMMUNICATIONS BRIDGES; LOCAL AREA NETWORKS; IBM TOKEN RING; IBM PC NETWORK; IBM CONNECTIVITY

Class_Codes: B6210L; C5620; D5020

....

1852081 B87020274, C87016387; Analysis of a kind of fault-tolerant interconnection network Jin, L.; Yang, Y. Dept. of Electr. Eng., Pennsylvania State Univ., University Park, PA, USA, Hwang, K.; Jacobs, S.M.; Swartzlander, E.E. (Editors)

Sponsor: IEEE; Pennsylvania State Univ.; ACM; Proceedings of the 1986 International Conference on Parallel Processing (Cat. No.86CH2355-6) 335-42 1986; 19-22 Aug. 1986 St. Charles, IL, USA

Publ: IEEE Comput. Soc. Press, Washington, DC, USA xviii+1051 pp. ISBN 0 8186 0724 6, U. S. Copyright Clearance Center Code: 0100-3918/ 86/0000 -0335$01.00

Treatment: PRACTICAL

Document Type: CONFERENCE PAPER

Languages: ENGLISH (6 Refs); With the aim of designing a highly available distributed computer system, an interconnection network with mixed static and dynamic topologies has been proposed and developed. A quantitative analysis is presented for the fault-tolerance performance of the network, including the processor connectivity and the worst-case diameter. The method used in the analysis is constructive in nature so that the result not only shows that the fault-tolerance capability of the proposed interconnection network is higher than that of other existing schemes, but also may serve as the basis of a distributed fault-tolerant routing algorithm with low space and time overheads.

Descriptors: COMPUTER NETWORKS; DATA COMMUNICATION SYSTEMS; DISTRIBUTED PROCESSING; FAULT TOLERANT COMPUTING

Identifiers: FAULT-TOLERANT INTERCONNECTION NETWORK; DISTRIBUTED COMPUTER SYSTEM; INTERCONNECTION NETWORK; DYNAMIC TOPOLOGIES; QUANTITATIVE ANALYSIS; PROCESSOR CONNECTIVITY; WORST-CASE DIAMETER; FAULT-TOLERANCE CAPABILITY; INTERCONNECTION NETWORK; DISTRIBUTED FAULTTOLERANT ROUTING ALGORITHM

Class_Codes: B6210L; C5220; C6150J; C5620

....

1842967 B87020208, C87016912; Inter-organization networks: implications of access control requirements for interconnection protocols Estrin, D. Dept. of Comput. Sci., Univ. of Southern California, Los Angeles, CA, USA

Sponsor: ACM; Comput. Commun. Rev. (USA) vol.16, no.3 254-64 Aug. 1986

CODEN: CCRED2 ISSN: 0146-4833; ACM SIGCOMM '86 Symposium on Communications Architectures and Protocols 5-7 Aug. 1986 Stowe, VT, USA; U. S. Copyright Clearance Center Code: 0-89791-201-2/86/0800-0254$00.75

Treatment: PRACTICAL

Document_Type: CONFERENCE PAPER

Languages: ENGLISH (18 Refs); When two or more distinct organizations interconnect their internal computer networks they form an Inter-Organization Network (ION). IONs support the exchange of CAD/CAM data between manufacturers and subcontractors, software distribution from vendors to users, customer input to suppliers' order-entry systems, and the shared use of expensive computational resources by research laboratories, as examples. The author analyzes the technical implications of interconnecting networks across organization boundaries. After analyzing the organization context in which IONs are used, the author demonstrates that such interconnections are not satisfied by traditional network design criteria of connectivity and transparency. To the contrary, a primary high-level requirement is access control, and participating organizations must be able to limit connectivity and make network boundaries visible. She describes a scheme based on nondiscretionary control which allows interconnecting organizations to combine gateway, network, and system-level mechanisms to enforce cross-boundary control over invocation and information flow, while minimizing interference with internal operations.

Descriptors: COMPUTER NETWORKS; PROTOCOLS

Identifiers: NETWORK INTERCONNECTION; ACCESS CONTROL REQUIREMENTS; INTERCONNECTION PROTOCOLS; INTER ORGANIZATION NETWORK; ION; TECHNICAL IMPLICATIONS; ORGANIZATION BOUNDARIES; NONDISCRETIONARY CONTROL; GATEWAY; NETWORK; SYSTEM-LEVEL MECHANISMS

Class_Codes: B6210L; C5620

....

1836336 C87016648; Multivendor interconnects provide dissimilar system connectivity Mueller, T.C.; Watanabe, B.M.; FlexLINK, Renton, WA, USA

Hardcopy (USA) vol.6, no.11 140-3 Nov. 1986

CODEN: HRDCEJ

ISSN: 0279-8123

Treatment: PRACTICAL

Document Type: JOURNAL PAPER

Languages: ENGLISH; Until a few years ago, mainframe computers primarily supported terminals. Then along came mini and microcomputers, and the emphasis shifted to distributed processing. Today, there's a need for mainframe computers to interconnect with these mini and microcomputers, and this need increasingly involves large amounts of data in time-critical environments. The mainframe has evolved into a repository for data files and a workhorse for computer-intensive operations.

Descriptors: MULTIPROCESSING SYSTEMS; SOFTWARE PORTABILITY

Identifiers: MULTIVENDOR INTERCONNECTS; SYSTEM CONNECTIVITY; MAINFRAME COMPUTERS; MICROCOMPUTERS; DISTRIBUTED PROCESSING; TIME-CRITICAL ENVIRONMENTS; DATA FILES; COMPUTER-INTENSIVE OPERATIONS

Class_Codes: C5440; C6110

....

1823013 C87010861; Multiple-bus interconnection for future multiprocessor systems Bhuyan, L.N. Center for Adv. Comput. Studies, Southwestern Louisiana Univ., Lafayette, LA, USA

Sponsor: US Army Res. Office; Proceedings of the Workshop on Future Directions in Computer Architecture and Software 98-101 1986 5-7 May 1986 Charleston, SC, USA

Publ: US Army Res. Office, Research Triangle Park, NC, USA v+414 pp.

Treatment: PRACTICAL

Document_Type: CONFERENCE PAPER

Languages: ENGLISH (15 Refs); The performance of multiprocessor systems depends largely on the performance of the interconnection network (IN) that connects processors to memories or processors to processors. In addition to providing full connectivity at low cost, the IN must be fault tolerant and be suitable for a varied class of algorithms that the system may execute. Although a lot of emphasis has been placed lately on a class of networks called multistage interconnection networks (MINs), they do not satisfy the later conditions. Recently there has been an upsurge of interest in multiple-bus systems. This system provides inherent simplicity of the single-bus architecture while providing a large bandwidth (BW) for data transfer. Also, it is suitable for any kind of algorithms and has an added advantage of fault-tolerance. The author presents the performance of both centralized and decentralized multiple-bus interconnections.

Descriptors: COMPUTER ARCHITECTURE; FAULT TOLERANT COMPUTING; MULTIPROCESSING SYSTEMS

Identifiers: FAULT TOLERANCE; MULTIPROCESSOR SYSTEMS; INTERCONNECTION NETWORK; CONNECTIVITY; MULTIPLE-BUS SYSTEMS; BANDWIDTH; DATA TRANSFER

Class_Codes: C5220

....

1380555 C85006545; UNIX GATEWAY SUTTERLIN, F. LOGISTICS MANAGEMENT SYST. CENTER, WRIGHT-PATTERSON AIR FORCE BASE, OH, USA COMPUTERWORLD (USA) VOL.18, NO.39B 67-8; 26 SEPT. 1984

CODEN: CMPWAB

ISSN: 0010-4841

Treatment: APPLIC; PRACTICAL

Document_Type: JOURNAL PAPER

Languages: ENGLISH; Reports on an intelligent gateway system, based on Berkeley 4.2 UNIX with Lawrence Livermore lab enhancements that will tie all of the logistics command's information systems. The Intelligent Gateway Processor (IGP) is much more than an interface between two networks. It does provide a user with the ability to connect to local-area networks, public data Networks, the Defense Data Network (DDN) and others, but the IGP provides much more service than just connectivity. It is a user's window to the world of information processing.

Descriptors: NETWORK OPERATING SYSTEMS; COMPUTER INTERFACES

Identifiers: BERKELEY 4.2 UNIX; INFORMATION SYSTEMS; INTELLIGENT GATEWAY PROCESSOR; LOCAL-AREA NETWORKS; PUBLIC DATA NETWORKS; DEFENSE DATA NETWORK; CONNECTIVITY

Class_Codes: C5610N; C6150J

....

No: L2 **Title:** Automated Electronic OMI's

Operations Requirement:

Operational and support procedures should be computer-based and maintained.

Rationale:

Conventional hard copy procedures are difficult and expensive to maintain. The manual update, copy and distribution of procedures does not provide for cost effective efficient operations. The lack of procedural discipline results in many errors. Automated procedures would control procedural sequence, data recording and associated support data presentation.

Sample Concept:

Procedures to be received from vendor in MIL-STD-1840A including graphics. These data then to be processed into an operational site procedure format. As procedures are scheduled for performance, the test conductor calls them up on on his terminal and follows display of instructions and sequences.

Technology Requirement:

Procedure authoring and update, standardize text and graphics formats.

Technology References:

NASA/RECON: 86N21206, 86N20477, 85N27754, 85N27121, 85N24835, 85N12793, 85N11603, 85A37968, 84N21406

DIALOG: 2037337, 2008924, 1783653, 1713486, 1670611, 1593032, 1502409, 1401285, 1381439, 1335095, 1221478

86N21206# ISSUE 11 PAGE 1850 CATEGORY 62 85/03/05 12 PAGES In DUTCH UNCLASSIFIED DOCUMENT DCAF E070116

UTTL: Standardization of local area networks (LANS): LAN service and LAN interface

AUTH: A/VANEGMOND, J.

CORP: Philips International B.V., Eindhoven (Netherlands). CSS: (Product Div. Telecommunications Systems.) AVAIL.NTIS

SAP: HC A09/MF A01 In Koninklijk Inst. van Ingenieurs Nationale LAN-Day. In Search of the Promised LAN 12 p (SEE N86-21202 11-62)

CIO: NETHERLANDS

MAJS: /*COMMUNICATION NETWORKS/ *COMPUTER NETWORKS/ *INTERFACES/ *LOCAL AREA NETWORKS/ *STANDARDIZATION

MINS: / CHANNELS (DATA TRANSMISSION)/ DATA LINKS/ DATA PROCESSING/ DATA TRANSMISSION/ PROTOCOL (COMPUTERS)/ TELECOMMUNICATION

ABA: Author (ESA)

ABS: Definition and standardization possibilities of a LAN technology independent interface within the Open Systems Interconnection Basic Reference Model were investigated. This standard interface would enable a simple connection between terminals and LAN's of different manufacturers. The importance with regard to future communication-integrated LAN's, providing for the communication in one building or complex, was emphasized. More kinds of communication on one LAN means the aptness of the LAN for the transport of data blocks and continuous data streams.

....

86N20477*# ISSUE 11 PAGE 1733 CATEGORY 18 RPT#: NASA-CR-177841 NAS 1.26:177841 MDC-H1343A-VOL-3 CNT#: NAS5-28082 85/12/00 7 VOLS 240 PAGES UNCLASSIFIED DOCUMENT

UTTL: Space station data system analysis/architecture study. Task 2: Options development, DR-5. Volume 3: Programmatic options

CORP: McDonnell-Douglas Astronautics Co., Huntington Beach, Calif. AVAIL.NTIS

SAP: HC A11/MF A01

CIO: UNITED STATES

MAJS: /*COMPUTER SYSTEMS PROGRAMS/ *END-TO-END DATA SYSTEMS/ *ORBITAL SPACE STATIONS/ *STANDARDIZATION/ *SYSTEMS MANAGEMENT

MINS: / COMMONALITY/ COMMUNICATION NETWORKS/ DATA BASE MANAGEMENT SYSTEMS/ MAINTAINABILITY/ PROCUREMENT/ QUALITY CONTROL/ SPACE COMMUNICATION/ STANDARDS/ SYSTEMS INTEGRATION

ABA: M.G.

ABS: Task 2 in the Space Station Data System (SSDS) Analysis/Architecture Study is the development of an information base that will support the conduct of trade studies and provide sufficient data to make design/programmatic decisions. This volume identifies the preferred options in the programmatic category and characterizes these options with respect to performance attributes, constraints, costs, and risks. The programmatic category includes methods used to administrate/manage the development, operation and maintenance of the SSDS. The specific areas discussed include standardization/commonality; systems management; and systems development, including hardware procurement, software development and system integration, test and verification.

....

85N27754# ISSUE 16 PAGE 2878 CATEGORY 82 RPT#: AD-A152201 DOD-5000.12-M-PT-1 84/10/00 174 PAGES UNCLASSIFIED DOCUMENT

UTTL: DOD manual for standard data elements, part 1

CORP: Department of Defense, Washington, D. C. CSS: (Directorate for Information Operations and Reports.) AVAIL.NTIS

SAP: HC A08/MF A01

CIO: UNITED STATES

MAJS: /*CODING/ *DATA BASE MANAGEMENT SYSTEMS/ *DATA PROCESSING/ *INDEXES (DOCUMENTATION)/ *STANDARDIZATION

MINS: / DEFENSE PROGRAM/ DOCUMENTS/ MANUALS

ABA: GRA

ABS: This Manual is published by DIOR provides a current reference source for DoD-approved standard data elements and codes. In addition, it contains general guidelines and criteria for the standardization of data elements and data codes. DoD 5000.12-M, December 1, 1982, is hereby CANCELLED. This volume contains an INTRODUCTION of background information on data element and data codes standardization, the organization of the Manual and how to use it. Section 2.0, STANDARDIZATION PROCEDURES AND CRITERIA, specifies the procedures for standardizing data elements and codes in the Department of Defense and the criteria to the applied in the standardization process. Section 3.0, DoD STANDARD DATA ELEMENTS AND CODES, contains listings of all DoD standard data elements and data codes by standard reference number, name and keyword out of context. Section 4.0, OBSOLETE DATA ELEMENTS AND CODES, lists the obsolete DoD Data elements and data codes in standard reference number order, alphabetically by name, and by keyword out of context.

....

85N27121# ISSUE 16 PAGE 2774 CATEGORY 32 RPT#: AD-A152134 84/09/00 109 PAGES UNCLASSIFIED DOCUMENT

UTTL: An analysis of data dictionaries and their role in information resource management TLSP: M.S. Thesis

AUTH: A/LANDIN, S. L.; B/OWENS, R. L.

CORP: Naval Postgraduate School, Monterey, Calif. AVAIL.NTIS

SAP: HC A06/MF A01

CIO: UNITED STATES

MAJS: / *COMPUTER PROGRAMS/ *DATA BASES/ *DICTIONARIES/ *MANAGEMENT INFORMATION SYSTEMS/ *STANDARDIZATION

MINS: /COMPUTER PROGRAMMING/ DISTRIBUTED PROCESSING/ GOVERNMENTS/ INFORMATION SYSTEMS/ RESOURCES MANAGEMENT/ UNITED STATES

ABA: GRA

ABS: The goal of efficient management of an organization's information resource can be accomplished through the implementation and use of a data dictionary. This thesis defines the structure and functions of a data dictionary and analyzes the attempt of the National Bureau of Standards to promulgate a standard software specification for use in the evaluation and selection of data dictionaries in the federal government. Criteria for the ideal data play in information resource management and are then used to evaluate four commercial data dictionary packages. Finally, some ideas concerning possible applications for data dictionary technology are presented.

....

85N24835*# ISSUE 14 PAGE 2406 CATEGORY 62 RPT#: NASA-CR-172582 NAS 1.26:172582 CNT#: NAG1-242 85/05/00 107 PAGES UNCLASSIFIED DOCUMENT

UTTL: Executive control systems in the engineering design environment

TLSP: M.S. Thesis

AUTH: A/HURST, P. W.

CORP: Virginia Univ., Charlottesville. CSS: (School of Engineering and Applied Science.) AVAIL.NTIS

SAP: HC A06/MF A01

CIO: UNITED STATES

MAJS: /*APPLICATIONS PROGRAMS (COMPUTERS)/ *ARCHITECTURE (COMPUTERS)/ *COMPUTER AIDED DESIGN/ *COMPUTER AIDED MANUFACTURING

MINS: / CLASSIFICATIONS/ COMPUTER SYSTEMS DESIGN/ STANDARDIZATION/ TECHNOLOGY TRANSFER

ABA: M.G.

ABS: An executive control system (ECS) is a software structure for unifying various applications codes into a comprehensive system. It provides a library of applications, a uniform access method through a central user interface, and a data management facility. A survey of twenty-four executive control systems designed to unify various CAD/CAE applications for use in diverse engineering design environments within government and industry was conducted. The goals of this research were to establish system requirements to survey state-of-the-art architectural design approaches, and to provide an overview of the historical evolution of these systems. Foundations for design are presented and include environmental settings, system requirements, major architectural components, and a system classification scheme based on knowledge of the supported engineering domain(s). An overview of the design approaches used in developing the major architectural components of an ECS is presented with examples take from the surveyed systems. Attention is drawn to four major areas of ECS development: interdisciplinary usage; standardization; knowledge utilization; and computer science technology transfer.

....

85N12793# ISSUE 3 PAGE 439 CATEGORY 82 RPT#: AD-A146350 84/03/00 67 PAGES UNCLASSIFIED DOCUMENT

UTTL: An approach to interfacing data bases in WWMCCS ADP

TLSP: M.S. Thesis

AUTH: A/MCCOY, S. K.

CORP: Naval Postgraduate School, Monterey, Calif. AVAIL.NTIS

SAP: HC A04/MF A01

CIO: UNITED STATES

MAJS: /*COMMAND AND CONTROL/ *DATA BASES/ *INFORMATION MANAGEMENT/ *INTERFACES

MINS: / COMMUNICATION NETWORKS/ DISTRIBUTED PROCESSING/ INFORMATION DISSEMINATION/ INFORMATION FLOW/ INFORMATION SYSTEMS/ INTERPROCESSOR COMMUNICATION/ STANDARDIZATION

ABA: Author (GRA)

ABS: Evolving requirements including the development of the Joint Operation Planning and Execution System (JOPES) are forcing the Worldwide Military Command and Control System (WWMCCS) ADP community toward the development of a distributed data base approach to information management. In this thesis the Electronic Data Interchange (EDI) concept is examined as a proposed system for realizing a distributed data approach. Using the EDI concept, any command which could translate to and from the EDI standard data set could exchange data with any other participating command. Implementation of this sort of system would facilitate interfaces among commands while not limiting participating commands to specific hardware, software, or data base management systems. The thesis proposes the EDI concept as a step toward realization of better data distribution and management in WWMCCS ADP.

....

85N11603# ISSUE 2 PAGE 245 CATEGORY 63 RPT#: AD-P003923 84/06/00 18 PAGES UNCLASSIFIED DOCUMENT

UTTL: An expert system for representing procedural knowledge

AUTH: A/GEORGEFF, M.

CORP: SRI International Corp., Menlo Park, Calif.

CSS: (Artificial Intelligence Center.) AVAIL.NTIS

SAP: HC A22/MF A01 In Denver Research Inst. Artificial Intelligence in Maintenance p 153-170 (SEE N85-11592 02-63)

CIO: UNITED STATES

MAJS: /*AUTOMATIC TEST EQUIPMENT/ *AUTOMOBILE ENGINES/ *EXPERT SYSTEMS/ *FAULT TOLERANCE/ *HEURISTIC METHODS/ *SYSTEMS ENGINEERING

MINS: /KNOWLEDGE/ MAINTENANCE/ MANAGEMENT METHODS/ REPRESENTATIONS/ SYSTEMS INTEGRATION

ABA: Author (GRA)

ABS: Development of effective automatic systems for fault isolation and diagnosis requires reasoning about sequences of tests and actions. Unfortunately, traditional expert systems are not well suited to representing such procedural knowledge. In this paper, a scheme is presented that allows the explicit representation of both declarative and procedural knowledge with a unified framework, yet retains all the desirable properties of expert systems such as flexibility, explanatory capability and extendability. In particular, the scheme allows any heuristic declarative knowledge that maintenance engineers may possess to be integrated easily and uniformly ~~with the strong~~ procedural methods of maintenance plans. Domain-specific metalevel knowledge can also be represented within the same formalism. A simple version of the scheme has been fully implemented and applied to the domain of automobile-engine fault diagnosis.

....

85A37968 ISSUE 17 PAGE 2468 CATEGORY 17 84/00/00 6 PAGES UNCLASSIFIED DOCUMENT

UTTL: Standard data procedures for future space projects

AUTH: A/MAYER, G. V.

PAA: A/(Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Wessling, West Germany)

CIO: GERMANY,FEDERAL REPUBLIC OF; (COSPAR, IUGS, COSTED, and United Nations, Workshops on Remote Sensing from Satellites, 1st and 9th, and Topical Meeting, Graz, Austria, June 25-July 7, 1984) Advances in Space Research (ISSN 0273-1177), vol. 4, no. 11, 1984, p. 175-180.

MAJS: /*DATA TRANSMISSION/ *PACKETS (COMMUNICATION)/ *SPACECRAFT COMMUNICATION/ *TELEMETRY

MINS: / END-TO-END DATA SYSTEMS/ EUROPEAN SPACE PROGRAMS/ NASA PROGRAMS/ PAYLOADS/ STANDARDIZATION

ABA: M.D.

ABS: An introduction to the end-to-end data system concept which considers both instrument and data autonomy is presented and future guidelines for packet telemetry and packet telecommand, initiated by a NASA/ESA working group and developed by an international consultative committee for space data systems, coordinated with six space agencies, are discussed. The status of the documents on standard data procedures is examined, with special emphasis given to the document on packet telemetry. Autonomous payload control, which is a pilot project for the study and the demonstration of the new data procedures, is described.

....

84N21406*# ISSUE 11 PAGE 1748 CATEGORY 82 84/04/00 6 PAGES UNCLASSIFIED DOCUMENT

UTTL: Automated RTOP management system

AUTH: A/HAYES, P.

CORP: National Aeronautics and Space Administration, Washington, D.C. AVAIL.NTIS

SAP: HC A08/MF A01 In its NASA Admin. Data Base Management Systems, 1983 p 13-18 (SEE N84-21403 11-82)

CIO: UNITED STATES

MAJS: /*DATA BASE MANAGEMENT SYSTEMS/ *INFORMATION MANAGEMENT/ *MANAGEMENT INFORMATION SYSTEMS/ *ON-LINE SYSTEMS/ *SYSTEMS ENGINEERING

MINS: / COMPUTER GRAPHICS/ COMPUTER NETWORKS/ COMPUTERS/ PROTOTYPES/ STANDARDIZATION/ SYSTEMS ENGINEERING

ABA: A.R.H.

ABS: The structure of NASA's Office of Aeronautics and Space Technology electronic information system network from 1983 to 1985 is illustrated. The RTOP automated system takes advantage of existing hardware, software, and expertise, and provides: (1) computerized cover sheet and resources forms; (2) electronic signature and transmission; () a data-based information system; (4) graphics; (5) intercenter communications; (6) management information; and (7) text editing. The system is coordinated with Headquarters efforts in codes R,E, ad T.

....

2037337 B87076456, C87067460; An operations system based on expert system techniques Sevcik, M. Siemens-Albis AG, Zurich, Switzerland

Sponsor: IEEE; International Switching Symposium 1987: 'Innovations in Switching Technology'. Proceedings (Cat. No.87CH2431-5) 160-5 vol.1 1987 15-20 March 1987 Phoenix, AZ, USA

Publ: IEEE, New York, NY, USA 4 vol. xxiv+1014 pp. U. S. Copyright Clearance Center Code: CH2431-5/87/0000- 0160$01.00

Treatment: PRACTICAL

Document_Type: CONFERENCE PAPER

Languages: ENGLISH (9 Refs); Principal concepts and implementation of an operations system are described. The salient feature of the underlying approach is the use of a formal knowledge representation of operation and maintenance procedures for digital switching systems. This knowledge base uses the SDL specification and description language, enriched by a rule-based approach for SDL-signal definition, and not only replaces the conventional operating manuals but will be automatically interpreted in an expert operations system connected online to the switches controlled. The implementation strategy is based on a personal computer (PC) and handles the operating and maintenance functions for the EWSD digital switching system. Extensions in the knowledge base allow for integration of other switching systems as well.

Descriptors: DIGITAL COMMUNICATION SYSTEMS; ELECTRONIC SWITCHING SYSTEMS; EXPERT SYSTEMS; MICROCOMPUTER APPLICATIONS; NETWORK OPERATING SYSTEMS

Identifiers: OPERATIONS SYSTEM; FORMAL KNOWLEDGE REPRESENTATION; OPERATION; MAINTENANCE; DIGITAL SWITCHING SYSTEMS; KNOWLEDGE BASE; SDL SPECIFICATION AND DESCRIPTION LANGUAGE; RULE-BASED APPROACH; SDL-SIGNAL DEFINITION; EXPERT OPERATIONS SYSTEM; PERSONAL COMPUTER; EWSD DIGITAL SWITCHING SYSTEM

....

2008924 B87072556, C87062557; Computerized automotive maintenance system (CAMS) Hamilton, S.C. Gen. Motors Corp., Detroit, MI, USA

Sponsor: Casa Risparmio Firenze; Province Florence; Thermotech. Assoc. Tuscany; Univ. Florence 16th ISATA: In Pursuit of Technical Excellence. Proceedings of the 16th International Symposium on Automotive Technology and Automation, with Particular Reference to Automotive MicroElectronics, Vehicle Management Systems and Computer-Aided Testing 119-29 vol.2 1987 11-15 May 1987 Florence, Italy

Publ: Automotive Autom. (1984), Croydon, Surrey, England 3 vol. (104+577+652) pp. ISBN0 947719 10 5

Treatment: PRACTICAL

Document_Type: CONFERENCE PAPER

Languages: ENGLISH; The desire for increased customer satisfaction, and therefore customer loyalty, has revealed a need for improved diagnostics systems for detecting problems associated with microprocessor based electronic controllers in automotive applications. General Motors' computerized automotive

maintenance system (GM-CAMS) is a device that was developed to accomplish this goal. GM-CAMS provides a service technician with an automated service tool that automatically tests, isolates failures, presents repair procedures, automatically retests after repairs are completed, and documents repair actions. GM-CAMS also provides the design engineering community with immediate feedback of field problems which can be analyzed and used to improve the design, manufacture and service of new products. The paper discusses the architecture of GM-CAMS with respect to its development philosophies, implementation strategies, fault isolation and analysis development, engineering feedback, information protocol, service technician interface and update capabilities.

Descriptors: AUTOMATIC TEST EQUIPMENT; AUTOMOBILES; ELECTRONIC ENGINEERING COMPUTING; FAILURE ANALYSIS; MAINTENANCE ENGINEERING

Identifiers: GENERAL MOTORS; AUTOMATIC TESTING; FAILURE ISOLATION; FAULT ANALYSIS; DIAGNOSTICS SYSTEMS; MICROPROCESSOR BASED ELECTRONIC CONTROLLERS; COMPUTERIZED AUTOMOTIVE MAINTENANCE SYSTEM; GM-CAMS; DESIGN ENGINEERING; DEVELOPMENT PHILOSOPHIES; IMPLEMENTATION STRATEGIES; ENGINEERING FEEDBACK; INFORMATION PROTOCOL; SERVICE TECHNICIAN INTERFACE; UPDATE CAPABILITIES

Class_Codes: B8520B; B0170N; B7210B; B0160; C7440; C7490; C7410D

....

1783653 B86070506, C86057733; Expert maintenance diagnostic system for the F-15 flight control system Davison, J.; Allstadt, M.A.; Bell, R.A.; Dittmar, C.J.; Hofmann, L.G.; Zampi, M.J.

Sponsor: IEEE; Proceedings of the IEEE 1986 National Aerospace and Electronics Conference, NAECON 1986 (Cat. No.86CH2307-7) 1335-42 vol.4 1986 19-23 May 1986 Dayton, OH, USA

Publ: IEEE, New York, USA 4 vol. 1399 pp. U. S. Copyright Clearance Center Code: 0547-3578/86/0000-1335$01.00

Treatment: PRACTICAL

Document_Type: CONFERENCE PAPER

Languages: ENGLISH; The development of a prototype expert system for the F-15 flight control system maintenance diagnostic procedure is reported. Emphasis is on the extent and structure of the rule base, and characteristics of the development environment and user interface. The purpose of this expert system application is to make all experts' knowledge of the flight control system available and accessible to the flight line technician, and by this means improve the technician's effectiveness and level of performance. This system isolated failures below the line replaceable unit (LRU) level. These failures are responsible for a significant fraction of flight control system LRU removals at the operational level which are later determined to retest okay (RTOK) at the intermediate shop level. Reduction of the RTOK rate is a unique contribution of this system, resulting from the sharper diagnostic procedures it can embody.

Descriptors: AEROSPACE COMPUTER CONTROL; AEROSPACE COMPUTING; AEROSPACE TEST FACILITIES; EXPERT SYSTEMS; MAINTENANCE ENGINEERING; USER INTERFACES

Identifiers: AEROSPACE COMPUTER CONTROL; F-15 FLIGHT CONTROL SYSTEM; PROTOTYPE EXPERT SYSTEM; MAINTENANCE DIAGNOSTIC; RULE BASE; USER INTERFACE

Class_Codes: B7630; B0160; B7620; C7460; C3360L; C7420

....

1713486 C86040386; Practical computer aided maintenance using the knowledge and distributing the data Jack, W.

Sponsor: IEE; IEE Colloquium on 'Practical Computer Aided Maintenance' (Digest No.59) 3/1-4 1986 23 April 1986 Edinburgh, Scotland

Publ: IEE, London, England 18 pp.

Treatment: PRACTICAL

Document_Type: CONFERENCE PAPER

Languages: ENGLISH; The role of the maintenance department, and their goals are outlined. However, reality tends to differ from theory and these problems are discussed by the authors. He outlines the potential advantages of computerizing maintenance procedures and describes criteria for the selection of such systems.

Descriptors: MAINTENANCE ENGINEERING

Identifiers: COMPUTER AIDED MAINTENANCE; MAINTENANCE DEPARTMENT; MAINTENANCE PROCEDURES

Class_Codes: C7160; C7410

....

1670611 C86029833; Building expert systems for repair domains Hofmann, M.; Caviedes, J.; Bourne, J.; Beale, G.; Brodersen, A. ITT Austria, Vienna, Austria; Expert Syst. (GB) vol.3, no.1 4-12 Jan. 1986

CODEN: EXSYEX

ISSN: 0266-4720

Treatment: PRACTICAL

Document_Type: JOURNAL PAPER

Languages: ENGLISH (13 Refs); The paper describes a conceptual framework for building expert systems in repair domains. A specific example of the use of this framework in building an expert system for a field service repair problem is given. The example system is designed to assist field service technicians in troubleshooting and repairing electronic systems at the board level. This system, a Field Service Advisor (Fieldserve), is designed to diagnose single or multiple defects in electronic systems, to guide a technician through appropriate repair procedures, to verify diagnoses and monitor repair effectiveness and to maintain records for subsequent evaluation and quality control.

Descriptors: COMPUTER MAINTENANCE; EXPERT SYSTEMS; SYSTEMS ANALYSIS

Identifiers: ELECTRONIC SYSTEMS REPAIR; DEFECT DIAGNOSES; EXPERT SYSTEMS; REPAIR DOMAINS; CONCEPTUAL FRAMEWORK; FIELD SERVICE REPAIR PROBLEM; FIELD SERVICE TECHNICIANS; TROUBLESHOOTING; FIELD SERVICE ADVISOR; FIELDSERVE; QUALITY CONTROL

Class_Codes: C6110; C7430; C0310D

....

1593032 C86010723; Experiences in computerizing plant maintenance (colliery plant) Addis, J. Min. Technol. (GB) vol.67, no.778 267-9, 271-3 Aug. 1985

CODEN: MNGTB7

ISSN: 0026-5276

Treatment: APPLIC

Document Type: JOURNAL PAPER

Languages: ENGLISH; This paper was written with the object of explaining how existing maintenance procedures have become more efficient with the aid of the computer. It is hoped that it will contribute a significant part in making the engineers' role, both mechanical and electrical, within the colliery management's objective more efficient by reducing the amount of downtime due to breakdowns, while maintaining equipment in a safe condition. The paper is sub-divided into six main categories: (1) explanation of the failings of the manual PPM scheme, (2) introduction to the facets of CPM, (3) preparatory work for inputting data into the computer, (4) operating the manager's scheme with the computer, (5) problems encountered with operation of pilot CPM, (6) future improvements and summary of CPM.

Descriptors: INDUSTRIAL COMPUTER CONTROL; MAINTENANCE ENGINEERING; MINING

Identifiers: COMPUTERIZING PLANT MAINTENANCE; MAINTENANCE PROCEDURES; COLLIERY MANAGEMENT'S; DOWNTIME; OPERATION

Class_Codes: C7420; C3310E; C7160

....

1502409 C85038319, D85002131; Managing maintenance Schneiderman, M. Can. Controls & Instrum. (Canada) vol.24, no.3 60-9 supl. May 1985

CODEN: CCISAU ISSN: 0008-3283

Treatment: GENERAL, REVIEW

Document_Type: JOURNAL PAPER

Languages: ENGLISH; An integrated approach to maintenance, both in selecting software programs and utilizing them on the shop floor, makes for better communications and, most importantly, keeps plant downtime to a minimum. Companies have begun to realize that a systematic integrated approach to maintenance and its management can go a long way towards making contributions in terms of: smoother, more controlled day-to-day operations; better and more timely information for decision making; and increased net profit. Today, a systematic, integrated approach to maintenance consists of five major elements: corporate attitude; administrative procedures; maintenance procedures; computer software; and maintenance computer. A reasonable balance among these five elements goes a long way towards ensuring the productivity and profitability of a manufacturing operation. An integrated approach will not, by itself, eliminate all calls from irate customers complaining about late deliveries or defective products. It can, however, greatly reduce the frequency of late deliveries that are due to breakdowns. It can also minimize the production of defective products attributable to the improper functioning of manufacturing equipment.

Descriptors: MAINTENANCE ENGINEERING; MANUFACTURE

Identifiers: INTEGRATED APPROACH; SHOP FLOOR; COMMUNICATIONS; PLANT DOWNTIME; CORPORATE ATTITUDE; ADMINISTRATIVE PROCEDURES; MAINTENANCE PROCEDURES; COMPUTER SOFTWARE; MAINTENANCE COMPUTER; MANUFACTURING OPERATION

Class_Codes: C7160; D2070

....

1401285 B85014670, C85010571; A hand-held man-machine interface using an electroluminescent matrix display DARLINGTON, E.S. TEXAS INSTRUM. INC., DALLAS, TX, USA

Sponsor: SID 1984 SID INTERNATIONAL SYMPOSIUM. DIGEST OF TECHNICAL PAPERS 186-8 1984; 5-7 JUNE 1984 SAN FRANCISCO, CA, USA

Publ: PALISADES INST. RES. SERVICES, NEW YORK, USA; 404 pp. U. S. Copyright Clearance Center Code: 0097-0966X/84/0000-186-$1.00+.00

Treatment: PRACTICAL

Document_Type: CONFERENCE PAPER

Languages: ENGLISH (3 Refs); Presentation of maintenance information to a military field technician is generally in the form of paper manuals. Desired information must be extracted by paging through the procedures, schematics and other data contained in those manuals. The Job Performance Aid (JPA) is a concept for presenting information via graphics and a controlled vocabulary to enhance comprehension. Dramatic reductions in maintenance errors and repair times have been demonstrated, but success of the concept is limited by its dependence on the paper medium. The Automated Maintenance Information System (AMIS) is an integrated concept for automating the development and delivery of JPAS. An interactive authoring system is used to develop the JPAS, and a portable, ruggedized delivery system is used to present them to the user. The delivery system is discussed.

Descriptors: FLAT PANEL DISPLAYS; ELECTROLUMINESCENT DISPLAYS; COMPUTER GRAPHIC EQUIPMENT; MILITARY EQUIPMENT; MILITARY COMPUTING; MAN-MACHINE SYSTEMS

Identifiers: MILITARY EQUIPMENT; MILITARY COMPUTING; FLAT PANEL DISPLAY; HAND-HELD MAN-MACHINE INTERFACE; ELECTROLUMINESCENT MATRIX DISPLAY; JOB PERFORMANCE AID; GRAPHICS; CONTROLLED VOCABULARY; MAINTENANCE ERRORS; REPAIR TIMES; AUTOMATED MAINTENANCE INFORMATION SYSTEM; AMIS; INTERACTIVE AUTHORING SYSTEM; RUGGEDIZED DELIVERY SYSTEM

Class_Codes: B7210D; B7260; B4260; C5540; C7150

....

1381439 C85007837; EXPERT SYSTEM FOR DIESEL ELECTRIC LOCOMOTIVE REPAIR BONISSONE, P.P.; JOHNSON, H.E., JR. CORP. RES. AND DEV., GEN. ELECTR. CO., SCHENECTADY, NY, USA HUM. SYST. MANAGE. (NETHERLANDS) VOL.4, NO.4 255-62 AUTUMN 1984

CODEN: HSMADU ISSN: 0167-2533 U. S. Copyright Clearance Center Code: 0167-2533/84/$3.00

Treatment: PRACTICAL

Document_Type: JOURNAL PAPER

Language: ENGLISH (15 Refs); General Electric Company's Corporate research and development has applied expert system technology to the problem of troubleshooting and the repair of diesel electric locomotives in railroad 'running repair shops'. The expert system uses production rules and an inference engine that can diagnose multiple problems with the locomotive and can suggest repair procedures to maintenance personnel. A prototype system has been implemented in forth, running on a digital equipment PDP 11/23 under RSX-11M. this system contains approximtely 530 rules (roughly 330 rules for the troubleshooting system, and 200 rules for the help system), partially representing the knowledge of a senior field service engineer. The inference engine uses a mixed-mode configuration, capable of running in either the forward or backward mode. The help system can provide the operator with assistance by displaying textual information, CAD diagrams or repair sequences from a video disk. The rules are written in a representation language consisting of nine predicate functions, eight verbs, and five utility functions. The first field prototype expert system, designated CATS-1 (Computer-Aided Troubleshooting SystemVersion 1), was delivered in July 1983 and is currently under field evaluation.

Descriptors: EXPERT SYSTEMS; MAINTENANCE ENGINEERING; DIESEL-ELECTRIC LOCOMOTIVES

Identifiers: DIESEL ELECTRIC LOCOMOTIVE; EXPERT SYSTEM; TROUBLESHOOTING; REPAIR; RUNNING REPAIR SHOPS; PRODUCTION RULES; INFERENCE ENGINE; MAINTENANCE PERSONNEL; FORTH; DIGITAL EQUIPMENT PDP 11/23; HELP SYSTEM; CATS-1; COMPUTER-AIDED TROUBLESHOOTING SYSTEM

Class_Codes: C7440; C7410

....

1335095 B84055186, C84043753; CATA: A COMPUTER-AIDED TEST ANALYSIS SYSTEM ROBACH, C.; MALECHA, P.; SCHLUMBERGER, E.P.; MICHEL, G. CIRCUITS AND SYSTEMS LAB., CNRS, SAINT MARTIN D'HERES, FRANCE; IEEE DES. AND TEST. COMPUT. (USA) VOL.1, NO.2 68-79 MAY 1984

ISSN: 0740-7475; U. S. Copyright Clearance Center Code: 0740-7475/84/0500 -0068$01.00

Treatment: PRACTICAL

Document_Type: JOURNAL PAPER

Languages: ENGLISH (14 Refs); The CATA (Computer-Aided Test Analysis) System helps engineers design systems for testability, both in manufacturing and field maintenance situations. CATA provides test program specifications automatically, and supplies both the information paths through the system and a top-down organization of test procedures. CATA can be applied at various levels of description (from behavioral to register transfer) and in various test contexts (e.g. board or system production). As a result, engineers can determine the expected degree of diagnosis resolution in terms of fault-isolatable hardware; they will also be guided toward the necessary system modifications. Software procedures for CATA are written in PASCAL and supported by a VAX 11-780 computer.

DESCRIPTORS: COMPUTERIZED INSTRUMENTATION; FAULT LOCATION

IDENTIFIERS: COMPUTER-AIDED TEST ANALYSIS SYSTEM; TESTABILITY; MANUFACTURING; FIELD MAINTENANCE; TEST PROGRAM SPECIFICATIONS; DIAGNOSIS RESOLUTION; FAULT-ISOLATABLE HARDWARE; PASCAL; VAX 11-780 COMPUTER

Class_Codes: B7210B; C3380B; C7410D

....

1221478 AD-A172 905/2/XAB; Man-Machine Interface Concepts for an Advanced Integrated Maintenance Information System (Final rept. May 85-Mar 86) Chenzoff, Andrew P. ; Evans, Debra C. ; Joyce, Reid P.; Roth, J. T. Applied Science Associates, Inc., Butler, PA. Corp.

Source_Codes: 086847000; 416572

Sponsor: Air Force Human Resources Lab., Brooks AFB, TX.; Report No.: AFHRL-TP-86-30 Sep 86 103p

Languages: English NTIS

Prices: PC A06/MF A01 Journal Announcement: GRAI8702; Country_of_Publication: United States

Contract_No.: N66001-83-D-0059; 2362; 00; The Air Force Human Resources Laboratory is developing the Integrated Maintenance Information System (IMIS). The purpose of this system is to consolidate all of the various information systems used in Air Force maintenance into a single set of hardware, software, and protocols. The IMIS will increase productivity by reducing the amount of training required for technicians to be able to access the full set of maintenance data and by making a wider range of data readily available to each technician. This paper explores the man-machine interface requirements of a system such as IMIS. By extrapolating current hardware and software trends into the future, it predicts the types of user-friendly features that will probably be available when the IMIS is fully implemented. It catalogs the types of information that need to be contained in such a maintenance information system. It outlines the relationships among the individual informational elements. It describes the data-processing functional requirements that should be present to process information in the system. It describes display formats for presenting each class of data and illustrates each format. It describes the interactive capabilities that must be incorporated to permit the technician to operate the system easily and effectively.

Descriptors: *MAN COMPUTER INTERFACE; SYSTEMS ENGINEERING; *INFORMATION SYSTEMS; REQUIREMENTS; INTEGRATED SYSTEMS; DISPLAY SYSTEMS; FORMATS; *DATA PROCESSING; USER NEEDS; AIR FORCE PLANNING; *AIRCRAFT MAINTENANCE

Identifiers: IMIS(Integrated Maintenance Information System); PRODUCTIVITY; IMIS SYSTEM; TRAINING; INTERACTIVE SYSTEMS; MAN MACHINE SYSTEMS; NTISDODXA; NTISDODAF

Section_Headings: 88B (Library and Information Sciences Information Systems); 95D (Biomedical Technology and Human Factors Engineering--Human Factors Engineering); 74E (Military Sciences Logistics, Military Facilities, and Supplies)

....

No.: L3 **Title:** Text and Graphical Data Acquisition

Operations Requirement:

Import and export of text and graphics requires that data formats be standardized. Eliminate hard copy transfer of text and data for information purposes and approvals.

Rationale:

The large volume of operations and support data is currently generated, maintained, and distributed in hard copy form and is highly labor intensive.

Sample Concept:

Text and graphics data imported and exported via MIL-STD-1840A.

Technology Requirement:

Text and graphics standards: MIL-STD-1840A

Technology References:

NASA/RECON: 86N17218, 84N24236

DIALOG: 2037208, 2027585

86N17218# ISSUE 7 PAGE 1196 CATEGORY 82

RPT#: DE85-017637 SAND-85-1248C CONF-8509155-1

CNT#: DE-AC04-76DP-00789 85/00/00 77 PAGES UNCLASSIFIED DOCUMENT

UTTL: Product Data Exchange Standard (PDES)

AUTH: A/KELLY, J. C.

CORP: Sandia National Labs., Albuquerque, N. Mex. AVAIL.NTIS

SAP: HC A05/MF A01

CIO: UNITED STATES; Presented at the Federal Computer Conference, Washington, D.C., 9 Sep. 1985

MAJS: /*AUTOMATION/ *COMPUTER AIDED MANUFACTURING/ *INFORMATION RETRIEVAL/ *STANDARDIZATION

MINS: / DATA BASE MANAGEMENT SYSTEMS/ INDUSTRIES/ PRODUCTS/ QUALITY

ABA: DOE

ABS: PDES stands for Product Data Exchange Standard. A long-term project, chaired by Kalman Brauner of The Boeing Company, currently exists within the IGES Committee to develop PDES. This project has two primary objectives: (1) to develop an exchange standard for product data in support of industrial automation, and (2) to represent the U.S. position in the International Standards Organization (ISO) arena relative to the development of a single worldwide standard for the exchange of product data. A new standard is being developed out of the belief that no existing standard can be extended to support industrial automation sufficiently well. Product Data is taken to be more general than product definition data. It includes data relevant to the entire life cycle of a product; manufacturing, quality assurance, testing, support, etc. Industrial product areas supported in previous exchange standards work within the IGES Committee includes mechanical, electrical, plant design, and AEC. While there is no inherent limitation in the PDES scope to these areas, it is naturally to be expected that these areas will be among the first to be addressed within PDES. Development of an exchange standard for product data involves settling on a set of logical structures to contain the product data information, and also settling on the manner in which these structures will be implemented in computer form.

....

84N24236# ISSUE 14 PAGE 2205 CATEGORY 61 RPT#: AD-A139347 TAEG-TN-11-83

CNT#: N61339-81-C-0091 83/12/00 264 PAGES UNCLASSIFIED DOCUMENT

UTTL: Computer aided layout of procedure information for training and job aiding

TLSP: Technical Note

AUTH: A/SYLLA, C.; B/BABU, A. J. G.

CORP: State Univ. of New York at Buffalo, Amherst. CSS: (Dept. of Industrial Engineering.) AVAIL.NTIS

SAP: HC A12/MF A01

CIO: UNITED STATES

MAJS: /*COMPUTER AIDED DESIGN/ *COMPUTER GRAPHICS/ *EDUCATION/ *FORMAT/ *HEURISTIC METHODS/ *LAYOUTS/ *TEXTS/ *TRAINING DEVICES

MINS: / COMPUTERS/ DATA PROCESSING/ HUMAN FACTORS ENGINEERING/ INFORMATION/ LEARNING/ PERSONNEL DEVELOPMENT/ PHOTOGRAPHS/ PROCEDURES/ TASKS/ VISUAL AIDS

ABA: GRA

ABS: Operation and maintenance tasks for modern military systems often include long and complex procedures. These procedures must be learned and then performed from memory with the help of simple checklists or comprehensive

procedures and also as aids in performing procedures. This report describes an effort to reduce the cost of producing text-graphic papers through the use of computer routines. The main concern is automating the layout process. A model was developed to optimally decompose a procedure into elements, to logically divide the elements into sets that can be displayed on individual pages, and to automatically format the rectangular objects into pages. A heuristic was developed to handle dividing the procedure into pages and the page formatting process. The arrangement and layout problem of a single page is formulated mathematically, and a heuristic procedure based on a pairwise exchange method was developed and used to solve this problem. The overall solution integrates these heuristics so as to mimic an intelligent human designer for the splitting of complex procedures into page sized segments and the formatting of these pages.

....

2037208 B88000694, C88002126 IEEE standard for logic circuit diagrams. Corrected edition

Issued_By: Inst. Electr. & Electron. Eng., New York, NY, USA; 1986 86 pp.

Report_No.: ANSI/IEEE Std 991-1986

Treatment: PRACTICAL;

Document_Type: REPORT

Languages: ENGLISH; ANSI/IEEE Std 91-1984 and ANSI/IEEE Std 991-1986 provide methods by which engineers, technicians, and service people can describe and understand the behavior and implementation of a logic circuit. ANSI/IEEE Std 91-1984 provides a way to describe a single logic function with a symbol, enabling users to understand the logic characteristics of these functions or devices without requiring specific knowledge of their internal characteristics. ANSI/IEEE Std 991-1986 deals with the selection of symbols, the representation of connections among them, labeling and annotation that further clarify the function of a circuit, and methods by which a circuit diagram may be coordinated with other forms of product documentation.

Descriptors: LOGIC CIRCUITS; STANDARDS

Identifiers: ANSI/IEEE STD 91-1984; ANSI/IEEE STD 991-1986; LOGIC CIRCUIT; LOGIC FUNCTION; SYMBOLS; REPRESENTATION; CIRCUIT DIAGRAM; PRODUCT DOCUMENTATION

Class_Codes: B1265B; C5120

....

2027585 B87076085, C87066574; C/sup 3/I interoperability in the Pacific Fontaine, R.K.; Towers, E.L. Signal (USA) vol.41, no.9 143, 145 May 1987

CODEN: SGNAAZ

ISSN: 0037-4938

Treatment: GENERAL, REVIEW

Document_Type: JOURNAL PAPER

Languages: ENGLISH; To achieve C/sup 3/I interoperability the US Pacific Command Combined Interoperability Program has been initiated. This accommodates both the bit oriented tactical digital information link and character oriented message text format standards. The program also includes configuration management of the documentation standards and testing of the systems that have implemented the standards.

Descriptors: COMMAND AND CONTROL SYSTEMS; MILITARY SYSTEMS; STANDARDS; TELECOMMUNICATION SYSTEMS

Identifiers: SYSTEMS TESTING; C/SUP 3/I INTEROPERABILITY; PACIFIC; BIT ORIENTED TACTICAL DIGITAL INFORMATION LINK; CHARACTER ORIENTED MESSAGE TEXT FORMAT; CONFIGURATION MANAGEMENT; DOCUMENTATION STANDARDS

Class_Codes: B6210; C7150

....

No: L4 **Title**: Automatic Test Requirements Verification

Operations Requirement:

Test requirements verification must be automatically correlated with the completion of the associated procedures.

Rationale:

Current manual method is inefficient, inadequate, and error prone.

Sample Concept:

An automated OMI is truly paperless, with sequence execution controlled by the scheduling systems and should track the completion of each procedure and task. As each task is completed, without error, or retest accomplished, all associated test requirements are automatically verified.

Technology Requirement:

Distributed data processing, networking, computer/data connectivity.

Technology References:

NASA/RECON: 85N30000, 85A33722, 84N33290, 84A26738, 82N23042

See also L2.

85N30000# ISSUE 19 PAGE 3226 CATEGORY 18

RPT#: NASA-CR-171513 NAS 1.26:171513 Z-410.1-84-175-VOL-2

CNT#: NAS8-35081 84/12/20 2 VOLS 134 PAGES UNCLASSIFIED DOCUMENT

UTTL: Space station automation study-satellite servicing, volume 2

TLSP: Final Report, Jun. - Nov. 1984

AUTH: A/MEISSINGER, H. F.

CORP: TRW Space Technology Labs., Redondo Beach, Calif. AVAIL.NTIS

SAP: HC A07/MF A01

CIO: UNITED STATES

MAJS: /*DESIGN ANALYSIS/ *MAN MACHINE SYSTEMS/ *MANIPULATORS/ *ORBITAL SERVICING/ *ORBITAL SPACE STATIONS/ *ROBOTICS/ *TECHNOLOGY ASSESSMENT/ *TELEOPERATORS

MINS: / ARTIFICIAL INTELLIGENCE/ MISSION PLANNING/ ORBIT MANEUVERING ENGINE (SPACE SHUTTLE)/ TECHNOLOGY UTILIZATION

ABA: J.W.G.

ABS: Technology requirements for automated satellite servicing operations aboard the NASA space station were studied. The three major tasks addressed: (1) servicing requirements (satellite and space station elements) and the role of automation; (2) assessment of automation technology; and (3) conceptual design of servicing facilities on the space station. It is found that many servicing functions cloud benefit from automation support; and the certain research and development activities on automation technologies for servicing should start as soon as possible. Also, some advanced automation developments for orbital servicing could be effectively applied to U.S. industrial ground based operations.

....

85A33722 ISSUE 15 PAGE 2140 CATEGORY 16 RPT#: SAE PAPER 840968 84/07/00 14 PAGES UNCLASSIFIED DOCUMENT

UTTL: EVA operations - Inception, verification and program implementation

AUTH: A/KING, K. R. PAA: A/(United Technologies Corp., Hamilton Standard Div., Windsor Locks, CT)

CIO: UNITED STATES; AIAA, SAE, ASME, AIChE, and ASMA, Intersociety Conference on Environmental Systems, 14th, San Diego, CA, July 16-19, 1984. 14 p.

MAJS: /*EXTRAVEHICULAR ACTIVITY/ *MAN MACHINE SYSTEMS/ *MISSION PLANNING/ *ORBITAL SERVICING/ *SPACE MAINTENANCE/ *SPACE SHUTTLE MISSIONS

MINS: / COST ANALYSIS/ HUMAN FACTORS ENGINEERING/ SPACE ENVIRONMENT SIMULATION/ SPACECRAFT DESIGN

ABA: L.T.

ABS: The benefits of a more extensive use of extravehicular activity (EVA) as a planned mission objective and of the approaches to a more efficient utilization of unplanned and contingency EVA are evaluated. Objectives and performances of previous EVAs are summarized, and the human vs machine preference for a given mission is analyzed. Moreover, approaches, facilities, and procedures associated with EVA simulation are discussed; fluid transfer devices, 1-G simulation techniques, and crew training are considered. It is pointed out that efficient implementation of EVA design and procedures would require the incorporation of the design factors from the start of the satellite program.

....

84N33290# ISSUE 22 PAGE 3674 CATEGORY 82 RPT#: AD-A143438 AFIT-LSSR-66-83 84/01/00 72 PAGES UNCLASSIFIED DOCUMENT

UTTL: An evaluation of two reliability and maintainability information systems

TLS: M.S.Thesis

AUTH: A/BOCK, L. K.

CORP: Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. CSS: (School of Systems and Logistics.) AVAIL.NTIS

SAP: HC A04/MF A01

CIO: UNITED STATES

MAJS: /*DATA BASES/ *DECISION MAKING/ *INFORMATION RETRIEVAL/ *MAINTAINABILITY/ *MANAGEMENT INFORMATION SYSTEMS/ *MILITARY OPERATIONS/ *RELIABILITY/ *WEAPON SYSTEMS

MINS: / ARMED FORCES (UNITED STATES)/ COMPATIBILITY/ DATA PROCESSING/ EVALUATION / MANAGEMENT METHODS/ OUTPUT/ PERFORMANCE TESTS/ REAL TIME OPERATION/ REQUIREMENTS/ SYSTEM EFFECTIVENESS

ABA: Author (GRA)

ABS: Air Force managers require adequate and timely information in order to make effective decisions regarding reliability and maintainability (R&M) issues. Since 1980, at least two Air Force organizations have contracted for additional computer data base systems to improve their R&M data requirements. These data base systems provide real-time maintenance and operational data on certain weapons systems. This study analyzed the output characteristics of these new data base systems to determine if they did provide improved information and comparison with the standard Air Force maintenance and operational data reports. It was shown that the two new data base systems did provide more timely R&M data which resulted in information that allowed for effective and efficient managerial decision making. However, all the timely information available for managerial decisions will be hindered until data input errors are reduced.

....

84A26738 ISSUE 11 PAGE 1500 CATEGORY 4 83/00/00 8 PAGES UNCLASSIFIED DOCUMENT

UTTL: Utilizing basic ICNIA capabilities to improve mission availability and reduce pilot workload — Integrated Communication, Navigation, Identification Avionics

AUTH: A/SMEAD, F. W.

PAA: A/(ITT, ITT Avionics Div., Nutley, NJ)

CIO: UNITED STATES

IN: Digital Avionics Systems Conference, 5th, Seattle, WA, October 31-November 3, 1983, Proceedings (A84-26701 11-06). New York, Institute of Electrical and Electronics Engineers, 1983, p. 9.5.1-9.5.8.

MAJS: /*AIRCRAFT EQUIPMENT/ *AVIONICS/ *RADIO EQUIPMENT

MINS: / CHECKOUT/ COMPUTERIZED SIMULATION/ CREW PROCEDURES (INFLIGHT)/ MAINTENANCE/ MISSION PLANNING/ RADIO NAVIGATION

ABA: J.N.

ABS: An over view of examples from an Integrated Communication Navigation Identification Avionics (ICNIA) computer simulation program is used to describe the benefits resulting from the use of programmable modules in the ICNIA, a highly digital, highly integrated, airborne CNI radio system. In the present design, embedded microprocessors control the real-time characteristics of parallel real-time-programmable modules and also control the interconnecting paths between modules. Representative ICNIA mission planning information is presented, including a list of mission phases for a strike mission and a list of CNI signals for in-flight refueling. Also considered are pre-flight checkout, impact of simulated failures on mission, pilot override and the bumping of AJ voice, and post-flight maintenance.

....

82N23042# ISSUE 13 PAGE 1873 CATEGORY 81 RPT#: PLRD-82-25 -205399 82/01/13 43 PAGES UNCLASSIFIED DOCUMENT

UTTL: Mission item essentiality: An important management tool for making more informed logistics decisions

TLSP: Report to the Secretary of Defense

CORP: General Accounting Office, Washington, D.C.

SAP: Avail: SOD

CIO: UNITED STATES

MAJS: /*CODING/ *DECISION MAKING/ *GOVERNMENT PROCUREMENT/ *INVENTORY MANAGEMENT/ *LOGISTICS/ *MAINTENANCE/ *MANAGEMENT METHODS/ *MISSION PLANNING/ *PRIORITIES/ *PROJECT PLANNING/ *RESOURCE ALLOCATION

MIN: COORDINATION/ OPERATIONS RESEARCH/ PROJECT MANAGEMENT/ SYSTEMS ANALYSIS/ SYSTEMS ENGINEERING

ABA: R.J.F.

ABS: Mission item essentiality, the means to which the essentiality of individual items is linked to mission essentiality to the end-item is discussed. It offers potential as a management tool for the services in making logistics decisions concerning requirements determination, resource allocation, and repair priorities. The Department of Defense developed a concept guide for use by the services. However, the department has allowed the services to proceed at their own pace and approach the matter from different areas; it was concluded the department should require the services to follow the concept guide and establish milestones for accomplishing the specific tasks set forth in the guide. The Air Force is ahead of the other services in developing a conceptually sound essentiality coding system, but ran into problems in implementing the system. Once the Air Force implementation problems have been solved, it is argued that the system will greatly benefit the Air Force in its logistics decision making process.

....

No.: L5 **Title:** Final Stage Assembly at Launch Site

Operations Requirement:

Perform initial stage assembly at manufacturing facility <u>near</u> Launch Center.

Perform all stage assembly, refurbishment and T&C/O in one low-bay building at the launch center; including horizontal installation of autonomous payload.

Rationale:

Simplifies transportation from manufacturing facilities to Launch Center.

Simplifies and minimizes assembly and T&C/O facilities. Eliminates a separate high-bay vehicle assembly building and large overhead lift-to-mate GSE.

More efficient use of personnel who can be cross-utilized for assembly and for checkout. Proximity of manufacturing facility to Launch Center further enables cross-utilization.

Sample Concept:

Reduce launch support facilities to three major categories:

1. Stage processing, T&C/O
2. Payload preparation
3. Launcher/pad

Technology Requirement:

None.

Technology References:

This document

No: **Title:**

L6 Horizontal Processing: Horizontal Transport
L7 Horizontal Transport of Individual Stages to Pad
L9 Erect/Mate Stages at Pad

The following is an exercise designed to quantify the reduction in shuttle-equivalent KSC headcount made possible by a dramatically simplified, innovative ground processing scenario. SLSOCs L6, 7, and 9 are presented individually with their proposed operations requirements, rationale, sample concept, technology requirements, and conclusions. They are directly related and interdependent.

The exercise is concluded with an integrated approach to quantify the potential headcount reduction by elimination of:

- o Mobile Launcher Platforms (MLP)
- o Crawler Transporters (C/T)
- o VAB high-lift/rotation/stacking scenario

Headcount compensation estimated for smaller, simpler mobile transfer and stage erection techniques is added. Autonomous flight stages and separately autonomous payload "cargo canisters" are keystone to the entire SLSOC in general, and this exercise in particular. Advantages of the concept are, of course, capped and further enhanced by the "barren pad" attributes of SLSOC Item No. L8.

See L9 "Conclusions" for quantified potential headcount reductions resulting from theoretical application of criteria L6, L7, and L9.

No: L6 **Title:** Horizontal Processing; Horizontal Transport

Operations Requirement:

Provide combination of flight vehicle design, inter-related ground processing requirements, and support facilities resulting in the simplest, least costly repetitive launch cycle. Horizontal mode proposed by this study.

GROUND PROCESSING MODE COMPARISON

Rationale

	VERTICAL	HORIZONTAL
Transportation	- complex transporter and self-leveling platform - greater clearance requirements	+ strap-on wheeled dolly or integral landing gear for recoverables
Handling	- requires extensive use of hoists/cranes/slings and strongbacks - vehicle must provide multipurpose attach points for element rotation - flight vehicles "in the air" during rotation, lift, & mate. pendulum effect creates tedious & hazardous operations.	+ individual element rotation not required prior to integration at pad + concept utilizes mobile crane with power-down controls for rotation (simplified capital equipment investment and O & M + flight vehicles always in contact with ground until launch
L V integration	- complex mate/demate operations	+ stage nesting or parallel mate reduces handling, simplified mate/demate
Rollout	- vehicle stacked on launch platform which must be mobile and self-leveling	+ rollout on gear or dollies - requires L V erector system at pad
Operational Access (vehicle)	O P F: + same as horizontal POST O P F: - circumferential access - provides diminished continuous vehicle access - increases logistical response - use of elevators or hoists/cranes - increases technicians response time - requires multiple entry access kits (vert., horiz.) (manufactured horiz.) - greater number of "hazardous area" clears due to overhead hoisting	POST OPF: + longitudinal access - substantial continuous vehicle access + decreases logistical response + increases operations efficiency - unique vehicle access kits required + conducive to parallel operations
Facilities	- requires tall structures with adequate "bay to bay" clearances - requires complex access platforms (extend/retract type) - increases O & M - requires multiple vehicle relocations: receipt, c/o and standard integration - requires crawlerway or equiv	+ barren pad; catastrophic damage greatly minimized + synergistic to production plant layout & application (common handling equip.) + reduces number of vehicle motions + lessens O & M + no separate vehicle integration facility (VAB) needed - requires paved roadway

L6 (Continued)

	VERTICAL	HORIZONTAL
Payloads	+ capable of handling vertical payloads + SIS non-DOD P/L's thru SIS-33 were: 80 horizontal 106 vertical + high orbit P/L's save critical weight with vertical processing + better payload access	- cannot handle vertical payloads + analysis of non-DoD SIS P/L's to-date shows the horizontal/vertical ratio could have been 149/37 for ALS instead of the 80/106 actual for SIS - high orbit P/L's require innovative horizontal support + STAS groundrule G-6, "for new systems, assume no payload change-out at the pad."

CONCLUSIONS:

- **Horizontal vehicle processing is more efficient**
- **Stages must be self transporting (integral landing gear) or utilize strap on dollies**

Sample Concept:

Horizontal T&C/O processing concept requires the following full-cycle ground operations description to demonstrate viability.

GROUND PROCESSING SEQUENCE

1. Flyback: -- booster lands at post-launch post-mission intervals at the SLF or equal.
2. Flyback: -- Stages safed and towed on integral landing gear to deservice/ refurbish/launch preparation. Facilities (OPF or equal).
3. Stages assembled/serviced and prepared for launch.
4. Autonomous payload canister/cocoon/pallet installed in orbiter in horizontal attitude in same facility by overhead crane (OPF or equal).
5. Stages towed in horizontal attitude on integral landing gear or wheeled dollies to launch pad and rotated to vertical about the aft wheels onto lift-off-style aft umbilical Q/D carriers, using specially selected mobile crane having power-down hook and boom systems, and horizontal vehicle-restraint wire rope system. Stages attached side-by-side. Any technician access via special mobile access manlift. Stage max. length limited by mobile crane boom-length/load radius capability. 180-ft. maximum stage length considered feasible state-of-art with existing KSC equipment.
6. Launch

Technology Requirement:

1. **Development of moderate-size stages with integral landing gear.**
2. **Radically simplified, autonomous (self-test/evaluation; self-contained electrical power) stages.**
3. **Radically simplied, "barren pad".**
4. **Acceptance/development of mobile crane usage for flight hardware based on highly satisfactory operational history at KSC.**

Technology References:

NASA/RECON (abstracts attached): 86X76652, 85N16967, 85N16927, 85N12001, 85A13163, 85A12988, 84X74531, 84N75063, 84A44153, 83X71371, 83A31196, 81A26524, 80X72115

86X76652 CATEGORY 14 86/07/16 5 PAGES UNCLASSIFIED DOCUMENT US GOV AGENCIES

UTTL: Baykonur

CORP: Joint Publications Research Service, Arlington, Va. MFC: 00 In its USSR Report: Space. Selected Articles from Encyclopedia of Cosmonautics (JPRS-USP-86-006-L) 5 p (SEE X86-76650 24-12)

CIO: U.S.S.R. Transl. into ENGLISH from the book '"Kosmonavtika: Entsiklopediya'' Moscow, USSR, Sovetskaya Entsiklopediya, 1985

MAJS: / *GROUND STATIONS/ *GROUND SUPPORT SYSTEMS/ *SATELLITE GROUND SUPPORT/ * U.S.S.R. SPACE PROGRAM

MINS: / LAUNCH VEHICLES/ LAUNCHING SITES/ PROTON SATELLITES/ SOYUZ SPACECRAFT

....

85N16967*# ISSUE 8 PAGE 1102 CATEGORY 16 85/01/00 15 PAGES UNCLASSIFIED DOCUMENT

UTTL: Mechanical features of the shuttle rotating service structure

AUTH: A/CRUMP, J. M.

CORP: Reynolds, Smith and Hills, Jacksonville, Fla. AVAIL.NTIS

SAP: HC A23/MF A01; In NASA. Johnson Space Center Space Shuttle Tech. Conf., Pt. 2 p 920-934 (SEE N85-16937 08-12)

CIO: UNITED STATES

MAJS: / *GROUND HANDLING/ *GROUND SUPPORT EQUIPMENT/ *LAUNCHING PADS/ *LOADING OPERATIONS/ *SPACE SHUTTLES/ *UNLOADING

MINS: / BEARINGS/ PIVOTS/ SPACE SHUTTLE ORBITERS/ SPACE SHUTTLE PAYLOADS/ THERMAL EXPANSION

ABA: R.S.F.

ABS: With the development of the space shuttle launching facilities, it became mandatory to develop a shuttle rotating service structure to provide for the insertion and/or removal of payloads at the launch pads. The rotating service structure is a welded tubular steel space frame 189 feet high, 65 feet wide, and weighing 2100 tons. At the pivot column the structure is supported on a 30 inch diameter hemispherical bearing. At the opposite terminus the structure is supported on two truck assemblies each having eight 36 inch diameter double flanged wheels. The following features of the rotating service structure are discussed: (1) thermal expansion and contraction; (2) hurricane tie downs; (3) payload changeout room; (4) payload ground handling mechanism; (5) payload and orbiter access platforms; and (6) orbiter cargo bay access.

....

85N16927*# ISSUE 8 PAGE 1096 CATEGORY 16 85/01/00 7 PAGES UNCLASSIFIED DOCUMENT

UTTL: External tank processing from barge to pad

AUTH: A/CARPENTER, J. E.

CORP: Martin Marietta Corp., Cocoa Beach, Fla. AVAIL.NTIS

SAP: HC A25/MF A01; In NASA. Johnson Space Center Space Shuttle Tech. Conf., Pt. 1 p 498-504 (SEE N85-16889 08-12)

CIO: UNITED STATES

MAJS: / *ASSEMBLING/ *BOOSTER ROCKET ENGINES/ *EXTERNAL TANKS/ *GROUND SUPPORT EQUIPMENT/ *LAUNCHING BASES/ *SOLID PROPELLANT ROCKET ENGINES

MINS: / CHECKOUT/ PROPULSION SYSTEM PERFORMANCE/ SYSTEMS ENGINEERING/ THERMAL PROTECTION

ABA: B.W.

ABS: Delivery and launch readiness events for the External Tanks (ET) are discussed. The ET is off-loaded at the KSC Barge Turning Basin and towed to the Vertical Assembly Building (VAB), High Bay Transfer Aisle. It is erected vertically and placed in the ET Checkout Area of High Bay 2 or 4 for standalone checkout. At the completion of checkout the ET is transferred to storage or to the Integration Area of High Bay 1 or 3 for SRB and Orbiter Mate. A Systems Integration Test performed with the Orbiter and Solid Rocket Booster is described. Final checkout activities are also described.

....

85N12001# ISSUE 3 PAGE 310 CATEGORY 15 84/01/24 10 PAGES UNCLASSIFIED DOCUMENT

UTTL: View of Ariane countdown procedures, Kourou launch facilities

AUTH: A/PEREZ, A.

CORP: Joint Publications Research Service, Arlington, Va. AVAIL.NTIS

SAP: HC A05/MF A01; In its West Europe Rept.: Sci. and Technol. (JPRS-WST-84-004) p 7-16 (SEE N85-11998 03-01)

CIO: FRANCE Transl. into ENGLISH from Ind. and Tech. (Paris), 10 Sep. 1983 p 74-83

MAJS: / *ARIANE LAUNCH VEHICLE/ *COUNTDOWN/ *LAUNCHING BASES/ *SPACECRAFT LAUNCHING

MINS: / GROUND CREWS/ GROUND SUPPORT EQUIPMENT/ LAUNCH WINDOWS/ LAUNCHING PADS/ LIQUID ROCKET PROPELLANTS

ABA: R.S.F.

ABS: Various activities, ground support equipment, procedures, and challenges associated with the launching of Ariane are described. Ground crew responsibilities, launch windows, rocket propellants, and technical personnel are among the topics discussed.

....

85A13163# ISSUE 3 PAGE 273 CATEGORY 14 RPT#: IAF PAPER 84-266 84/10/00 15 PAGES UNCLASSIFIED DOCUMENT

UTTL: Space Shuttle ground processing - The safety challenge

AUTH: A/BREM, H. L., JR. PAA: A/(Lockheed Space Operations Co., Titusville, FL)

CIO: UNITED STATES; International Astronautical Federation, International Astronautical Congress, 35th, Lausanne, Switzerland, Oct. 7-13, 1984. 15 p.

MAJS: / *GROUND HANDLING/ *SAFETY FACTORS/ *SPACE TRANSPORTATION SYSTEM

MINS: / GROUND CREWS/ GROUND SUPPORT EQUIPMENT/ HAZARDS/ LOGISTICS/ TECHNOLOGY ASSESSMENT

ABA: Author

ABS: This paper discusses the safety aspects of the ground processing of the 'Space Shuttle': It describes in general terms the flow of the processing from orbiter landing to the succeeding launch. It notes in some detail the known hazards associated with the Space Transportation System and the impact these hazards have on a single serial processing flow e.g., the requirements clearing work areas of nonessential personnel to accommodate possible exposures to toxic vapors and liquids or the hazards associated with solid rocket motor segments. It then describes how these hazards and limitations have significantly greater impact when considered in light of the multiple flow processing required to meet increasing launch rates.

....

85A13163# ISSUE 3 PAGE 273 CATEGORY 14 RPT#: IAF PAPER 84-266 84/10/00 15 PAGES UNCLASSIFIED DOCUMENT

UTTL: Space Shuttle ground processing - The safety challenge

AUTH: A/BREM, H. L., JR. PAA: A/(Lockheed Space Operations Co., Titusville, FL)

CIO: UNITED STATES; International Astronautical Federation, International Astronautical Congress, 35th, Lausanne, Switzerland, Oct. 7-13, 1984. 15 p.

MAJS: / *GROUND HANDLING/ *SAFETY FACTORS/ *SPACE TRANSPORTATION SYSTEM

MINS: / GROUND CREWS/ GROUND SUPPORT EQUIPMENT/ HAZARDS/ LOGISTICS/ TECHNOLOGY ASSESSMENT

ABA: Author

ABS: This paper discusses the safety aspects of the ground processing of the 'Space Shuttle': It describes in general terms the flow of the processing from orbiter landing to the succeeding launch. It notes in some detail the known hazards associated with the Space Transportation System and the impact these hazards have on a single serial processing flow e.g., the requirements clearing work areas of nonessential personnel to accommodate possible exposures to toxic vapors and liquids or the hazards associated with solid rocket motor segments. It then describes how these hazards and limitations have significantly greater impact when considered in light of the multiple flow processing required to meet increasing launch rates.

....

84X74531# CATEGORY 14 RPT#: AD-B078528L FTD-ID(RS)T-1278-83 83/11/28 9 PAGES UNCLASSIFIED DOCUMENT US GOV AGENCIES

UTTL: Launch point - Plesetsk

AUTH: A/GUBAREV, V.

CORP: Air Force Systems Command, Wright-Patterson AFB, Ohio. CSS: (Foreign Technology Div.)

CIO: U.S.S.R. Transl. into ENGLISH from Pravda (USSR), no. 171(23697), 20 Jun. 1983 p 3, cols 2-8

MAJS: / *ARTIFICIAL SATELLITES/ *BOOSTER ROCKET ENGINES/ *LAUNCHING SITES

MINS: /CONSTRUCTION/ GROUND SUPPORT EQUIPMENT/ SITE SELECTION

....

84N75063* CATEGORY 82 RPT#: NASA-TM-85500 K-STMS-01 NAS 1.15:85500 1984/04/00 0 PAGES UNCLASSIFIED DOCUMENT

UTTL: Space Transportation System: Facilities and operations

CORP: National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla. AVAIL.NTIS

CIO: UNITED STATES

MAJS: / *CAPE KENNEDY LAUNCH COMPLEX/ *GROUND SUPPORT EQUIPMENT/ *SPACE SHUTTLES/ * SPACE TRANSPORTATION SYSTEM

MINS: /LAUNCHING PADS/ PROPELLANT STORAGE/ SPACE SHUTTLE PAYLOADS/ SUPPORT SYSTEMS/ TURNAROUND (STS)

....

84A44153 ISSUE 21 PAGE 3005 CATEGORY 14 84/08/00 4 PAGES UNCLASSIFIED DOCUMENT

UTTL: Spaceport Guiana

AUTH: A/CHARTRAND, M.

PAA: A/(National Space Institute, Arlington, VA)

CIO: UNITED STATES; Space World (ISSN 0038-6332), vol. U-8-248, Aug. 1984, p. 26-29.

MAJS: / *EUROPEAN SPACE PROGRAMS/ *LAUNCHING BASES

MINS: / ARIANE LAUNCH VEHICLE/ FRENCH GUIANA/ FRENCH SATELLITES/ GROUND SUPPORT EQUIPMENT

ABA: M.S.K.

ABS: The management, conditions, capabilities, and projects of the Guiana launch center are reviewed. The facility

is now controlled by Arianespace, a private corporation with semiprivate stockholders. Arianespace, actually a marketing firm, claims that the Ariane can place spacecraft into more precise geostationary transfer orbits than can the Shuttle, thereby extending GEO spacecraft lifetimes by a year due to conserved stationkeeping fuel. Furthermore, the added speed gained by a rocket launched from near the equator increases the fuel efficiency by 17 percent. A second launch pad is being readied, and on-site facilities include a vertical integration building for computerized system check-out prior to launch. Launch rates of 12 per year are planned, with the vehicles transported from the assembly building to pad on a rail car apparatus. The first purely commercial launch placed Spacenet-1 in GEO for telecommunication relay functions.

....

83X71371# CATEGORY 12 82/11/19 9 PAGES UNCLASSIFIED DOCUMENT US GOV AGENCIES

UTTL: Air and Cosmos report from Baykonur Cosmodrome

AUTH: A/LANGEREUX, P.

CORP: Joint Publications Research Service, Arlington, Va. In its USSR Rept.: Space (JPRS-L/10955) p 1-9 (SEE X83-71370 05-12)

CIO: FRANCE - Transl. into ENGLISH from Air and Cosmos (Paris), no. 916, 17 July. 1982 p 57-60 and 68

MAJS: / *LAUNCHING BASES/ *LAUNCHING SITES/ *U.S.S.R. SPACE PROGRAM

MINS: /GROUND SUPPORT EQUIPMENT/ ROCKET LAUNCHING/ SPACECRAFT LAUNCHING

....

83A31196# ISSUE 13 PAGE 1811 CATEGORY 14 CNT#: F04701-80-C-0081 82/00/00 17 PAGES UNCLASSIFIED DOCUMENT

UTTL: DOD/Shuttle payload ground handling operations at Kennedy Space Center

AUTH: A/STRANG, N. L.

PAA: A/(Aerospace Corp., Vehicle Engineering Div., El Segundo, CA)

CIO: UNITED STATES; IN: Aerospace Testing Seminar, 6th, Los Angeles, CA, March 11-13, 1981, Proceedings (A83-31176 13-14). Mount Prospect, IL, Institute of Environmental Sciences, 1982, p. 195-206; Discussion, p. 207-211.

MAJS: / *CAPE KENNEDY LAUNCH COMPLEX/ *GROUND HANDLING/ *GROUND SUPPORT EQUIPMENT/ * SPACE SHUTTLE PAYLOADS

MINS: / FACILITIES/ LAUNCHING PADS/MATERIALS HANDLING/PAYLOAD INTEGRATION

ABA: C.D.

ABS: A description is presented of the facilities and support equipment which will be used at Kennedy Space Center for processing vertically installed DOD payloads from the time the payload elements arrive at the launch site until the complete integrated cargo is installed in the Shuttle bay. The facilities treated include the solid motor assembly building, the Shuttle payload integration facility, the rotating service structure, and the Orbiter Processing Facility. The flow of payload elements through these facilities and the manner in which they are integrated, checked out, serviced, and installed in the various handling fixtures are discussed. The operational problems associated with handling, cleanliness, propellant servicing, safety, and event scheduling are emphasized.

....

81A26524 ISSUE 10 PAGE 1583 CATEGORY 14 81/04/00 8 PAGES UNCLASSIFIED DOCUMENT

UTTL: The Baikonur SS-6 space launch facilities

AUTH: A/JOHNSON, N. L.

CIO: UNKNOWN Spaceflight, vol. 23, Apr. 1981, p. 109-116.

MAJS: / *GROUND SUPPORT SYSTEMS/ *LAUNCH VEHICLES/ *LAUNCHING BASES/ *LAUNCHING PADS / *U.S.S.R. SPACE PROGRAM

MINS: / CHECKOUT/ GANTRY CRANES/ INTERCONTINENTAL BALLISTIC MISSILES/ LIQUID OXYGEN/ REFUELING/ ROCKET PROPELLANTS/ SOYUZ SPACECRAFT

\BA: O.C.

ABS: An historical and operational survey is made of the Soviet Union's Boikonur 'Pad A' and 'Pad B' satellite-booster launching methods, used from 1957 to the present day for exclusive use by derivatives of the early SS-6 ICBM design. The launch facilities considered are those of the Baikonur Cosmodrome near the town of Tyuratam, east of the Aral Sea. A conjectural chronology of launch pad design, construction and modification in response to changing payload configurations is given in conclusion.

....

80K72115 CATEGORY 14 RPT#: JPRS-L/8845 80/01/07 308 PAGES UNCLASSIFIED DOCUMENT US GOV AGENCIES

UTTL: Cosmodrome

AUTH: A/VOLSKIY, A. P. PAT: A/ed.

CORP: Joint Publications Research Service, Arlington, Va.

CIO: U.S.S.R. Transl. into ENGLISH of the book "Kosmodrom" Moscow, Voyenizdat, 1977 312 p

MAJS: / *GROUND SUPPORT EQUIPMENT/ *GROUND SUPPORT SYSTEMS/ *LAUNCHING BASES/ *LAUNCHING PADS/ *SPACECRAFT LAUNCHING

MINS: / FUEL SYSTEMS/ GROUND-AIR-GROUND COMMUNICATION/ LAUNCH VEHICLES/ ROCKET TEST FACILITIES/ SPACECRAFT GUIDANCE/ TEMPERATURE CONTROL

No: L7 **Title**: Horizontal Transport of Individual Stages to Pad

Operations Requirement:

Eliminate LV rotation, high-lift VAB scenario, and the related extensive GSE and GSO army. Provide simple, rapid transit of flight stages through the ground processing cycle: from landing site (if recoverable) or stage assembly facility (if expendable), to processing facility, to launch pad.

Rationale:

Conventional rotation, lift, and mate in the VAB requires large mobilization for complex, interrelated GSO, equipment, and personnel.

The operational efficiency and cost reduction potential of this concept are strongly dependent on capability to insert the payload cocoon as late as practical in the flow, i.e., immediately before vehicle transfer to pad. Use of landing gear, or strap-on dollies and aircraft tug-type operation (or rail/locomotive configuration) eliminate the need for large, O&M-intensive crawler-transporter (CT) and mobile launcher platform (MLP), and allow rapid transit.

Sample Concept:

Perform T&C/O of all stages in horizontal attitude. Only one set and type of access GSE is required. Complete T&C/O, roll individual stages to pad, rotate to vertical with mobile crane and engage stage-mate clevis. Simplified vehicle and pad are key to reduced time at pad. If access for vertical payload insertion were made mandatory, it would cause the return of costly structures and O&M army and compromise the "barren-pad" concept.

Transit via integral landing gear or strap-on dollies also allows individual stage transfer to the pad and individual rotation - to - vertical about the wheels, or suitable pivot axis, using a mobile crane while maintaining ground contact with the stage. This would provide the following benefits:

(1) Rapid/timely transfer of individual stages to pad.

(2) Minimum payload ground loiter time subsequent to insertion in vehicle.

(3) Requires roadway capable of supporting stages individually, but crawler-transporter and mobile launcher platform are not required; gravelled crawlerway and repetitive dragging / smoothing and gravel replacement not necessary.

(4) Erection GSE greatly simplified. At KSC mobile cranes are routinely maintained and available. Rotation to vertical can be accomplished without lifting flight vehicle from ground; assures full control of vehicle while "on-the-hook", greatly improving safety of the operation. This method would also greatly increase the operational wind envelope normally associated with loads lifted clear of the ground.

(5) For a ground processing scenario limited to horizontal vehicle handling, transit to pad can be either individual or piggyback. The concept of individual stage transport promises a lighter booster, simpler processing facility (eliminates major vehicle lift), and simpler structural dynamics during transfer.

L7 - Horizontal Transport of Individual Stages to Pad (Cont.)

Technology Requirement:

Simplified launch vehicle and greatly revised design and operations philosophy aimed at eliminating all possible GSE and ground support operations.

Proposed pad and vehicle are very much simplified from conventional concepts. Vehicle simplification, as proposed in other items herein, eliminates dependence on multi-level vehicle access/connections provided by swingarms.

Technology References:

None.

Conclusions:

See L9 "Conclusions" for theoretical quantified headcount reduction associated with criteria L6, L7, and L9.

No.: L8 **Title:** Barren Pad

Operational Requirement:

Barren pad with essentially no GSE or supporting structures.

Rationale:

A major contributor to ground operations cost is the complexity of GSE and structures at the pad which require constant maintenance and/or refurbishment and modifications; each of which require small armies of supporting personnel (engineers, technicians, mechanics, clerks, etc.)

The following SPC systems, responsibilities, and headcount during 51-L are representative of "hands-on" Operations elements not required by a barren pad concept; i.e., headcount and systems that can be deleted from future designs. It does not include process/sustaining engineering, QA, safety, logistics, etc.

PADS 39 A & B - Pad systems, in general, are covered 24 hrs., 7 days, 3 shifts, using an odd work week schedule. Skill mix includes certified mechanical and electrical technicians, generally performing the following variety of O&M functions:

- o Planned maintenance: cyclic preventive maintenance, including corrosion control, pressure tests, proof tests, and component/system calibrations
- o Unplanned maintenance: resolution of anomalies documented by PR's and DR's, and applicable re-test
- o Modifications: implementation of ground system changes and applicable re-test
- o STS processing: mating, testing, servicing and closeout for launch as dictated by the processing schedule

The following KSC shuttle systems and headcount are eliminated by a barren pad configuration.

ENVIRONMENTAL CONTROL SYSTEM (ECS); 51-L HEADCOUNT = 32

The ECS system provides air or GN2 to various compartments of the orbiter, PCR white room, external/inter tank area, and localized payload air conditioning.

The ECS system provides temperature, humidity, and pressure levels to these various systems.

ECS system technicians routinely have to adjust temperature or flow rates per OTC or engineering.

SWING ARMS/HYDRAULICS FOR SWING ARMS; 51-L HEADCOUNT = 25

Maintain and service all associated systems including pneumatic systems and lines.

Hydraulic charging unit and piping, GOX vent arm, ET vent arm, orbiter access arm, ECS air for ET access and GOX vent arms.

L8 (cont.)

PAYLOAD CHANGEOUT ROOM (PCR) AND PAYLOAD GROUND HANDLING MECHANISM (PGHM); 51-L HEADCOUNT = 26

PCR fixed platforms, extendible platforms, PCR doors, ante room, and air shower maintenance and PCR cleaning prior to payload installation.

PGHM drive mechanism, hydraulic system, J-hook, support beam, LRU extendible platforms, counter balance beams and associated hardware, includes crane and hoist operation.

Processing of vertical payloads both commercial and DoD into the PCR and installation in the orbiter and payload bay, closeout for launch.

LAUNCH COMPLEX SITE MANAGEMENT AND MATRIX SUPPORT COORDINATION;
51-L HEADCOUNT = 28 BARREN PAD = 17 (28 less 40%)

Direct supervision and management of ground support equipment technicians and coordination of site support requirements to ensure readiness of the site to support the vehicle processing schedule.

This function includes all non-technician staffing, i.e., site manager, shift managers, systems supervisors, site support coordination, secretarial and clerical.

PAD OPERATIONS QUANTIFIERS (51-L)

- OMI S0009, Launch Pad Validation = 82 technicians
- OMI S0024, Hypergol Propellant Servicing = 70 technicians
- PRs, DRs, TPSs, average/month = 120 per pad
- PMOMIs released into work control system/month = 80 per pad.
- Payload installation at PCR (13.0 hours design) required 174 hours.

51-L SYSTEMS NOT ELIMINATED BY BARREN PAD EXERCISE

- Hazardous gas detection, GH2 leak/fire detection; 51-L headcount = 23
- Hypergolic systems; 51-L headcount = 42
- PRSD/fuel cells; 51-L headcount = 25
- LH2 MPS storage /transfer; 51-L headcount = 19
- LO2 MPS storage/transfer; 51-L headcount = 20

ESTIMATE OF ADDITIONAL FACILITIES O&M HEADCOUNT ELIMINATED BY BARREN PAD

o Low voltage electrical;	59 x .25 = 15
o Pneumatics;	29 x .25 = 7
o HVAC/ECS;	42 x .25 = 10
o Industrial water;	37 x .8 = 30
o C/T, MLP, Pad Structures;	51 x .06 = 3
o Cranes, doors, platforms, elevators;	90 x .06 = 5
Total:	70

Sample Concept:

A "barren pad" would have the following essentials:

* Simple raised concrete structure
* Deep water exhaust buffer
* Lightning/lighting tower
* Propellant farm
* Mobile crane (as required)
* Flyaway propellant connections
* Hardwire electrical ground connections
* Wireless (infrared/optical/RF) control & data connections

It would not have:

* Access structures
* Swingarms
* Retracting umbilicals
* T-0 holddown
* Firebrick flame trench and deflectors
* Deluge water system
* Sound suppression water system
* Extensive air compressor system
* Extensive helium and nitrogen storage and distribution systems
* Large pad terminal connection room
* Ground power system and related GSE
* ECS GSE
* Vehicle system GSE
* Hardwire connections to vehicle
* Office and shop facilities

Technology Requirement:

Development only; heavily dependent on acquisition of autonomous payload units mated in an innovative manner, eliminating the need for a "payload city" anywhere in the ground processing/launch facilities scenario.

Also heavily dependent on autonomous vehicle having presently unavailable self-contained electrical power system.

Technology References:

None.

Conclusions:

A "barren pad" has the potential to decrease the "STS equivalent" pad operations and facilities headcount by 170 people; not including QA, safety and the support infrastructures. The Phase 3 Addendum to Phase 2 Final Report of this study, "51-L Work Volume Indicators", dated September 30, 1988 (page 3) shows the SPC skill mix includes 32.1% "untabulated administrative" (QA, safety, secretarial, analysts, clerks, security, business, human resources, etc.). Applying that ratio to the 170 heads above provides a conservative additional reduction of 170 x .32 = 54; for a total potential headcount reduction of 224 people.

No: L8.1 **Title:** Deep Water Exhaust Buffer

Operations Requirement:

Eliminate/minimize/simplify launch pad flame trench and deflector.

Rationale:

Contemporary launch pads are massive structures whose initial capital cost include significant expense for fire brick, flame deflectors, water deluge systems, water control masonry, and retention ponds. Maintenance and operation of these systems represents a sizable workload and headcount for the facilities organization. The thermodynamic and acoustic environment during launch is extreme with physical deterioration a function of launch rate. Future launch vehicles, with increased launch rates, are envisioned. Replacement of damaged or eroded firebrick, major refurbishment at repetitive intervals, and and even modest structural erosion of flame deflectors is costly. These should be greatly reduced or virtually eliminated.

Sample Concept:

Construct the new pad with typically deep pilings and footers, although not necessary to support weight of MLPs and towers (they aren't used in proposed pad). Dredge very deep pond at base of flame duct (40-60 ft. deep). Utilize gravity-fed (no pumps) natural body of water such as a lake, river, or ocean connected by low-maintenance canal. Deep water will serve to quench exhaust and act as flame deflector.

Technology Requirement:

Investigate water depth requirement as function of thrust level and rocket engine geometry.

Technology References:

This document. See L8 "Conclusions" for potential headcount reduction associated with this criterion.

No: L8.2 **Title:** Flyaway Connects Only - No Retracting Umbilical Carrier Plates

Operations Requirement:

Provide simplified vehicle umbilical disconnect systems.

Rationale:

Contemporary retracting quick-disconnect umbilical carriers are very complex, suceptible to launch-damage, and manpower-intensive for test and checkout. Post-launch refurbishment is repetitive, costly, and time consuming.

Sample Concept:

Proposed pad has no vehicle access towers, swingarms or retracting umbilical carrier plates. All hard connects to the vehicle (essentially propellant lines) are vertical lift-off type with simple, gravity operated protective covers for QDs and the carrier plate.

Technology Requirement:

None.

Technology References:

This document. See L8 "Conclusions" for potential headcount reduction associated with this criterion.

No: L8.3 **Title**: No Swingarms

Operations Requirement:

Eliminate all swingarms with the related ground support operations, equipment, and structures to dramatically reduce repetitive costs. Eliminate repetitive tests and checkout at pad and post launch refurbishment.

Rationale:

Contemporary swingarms are expensive, complex, O&M intensive, and launch critical systems.

Sample Concept:

Proposed pad and vehicle are very much simplified compared to conventional concepts. Vehicle simplification, as proposed in other items herein, eliminates dependence on multi-level vehicle access/connections provided by swingarms. Payload canister inserted during T&C/O prior to transfer to pad. Passenger canister access (if any) via special mobile manlift.

Technology Requirement:

Concept dependent on development of simplified vehicle by related technology developments proposed in other items herein.

Technology References:

This document. See L8 "Conclusions" for potential headcount reduction associated with this criterion.

No: L8.4 **Title:** No Vehicle or Payload Access Structure

Operations Requirement:

No vehicle or payload access structure.

Minimize vehicle resident time at pad. Rollout, erect, fuel, verify satisfactory self-test, launch.

Limited LRU changeout capability at pad (boattail).

Rationale:

Current STS requires two weeks or more at the pad for extensive interface systems test and checkout, payload access for O&M, vertical P/L insertion, closeout and all-systems verifications. This time period and tedious process is not acceptable for reduced cost and high launch rate.

Sample Concept:

Mandatory access for vertical payload insertion would return the likelihood of costly structures and O&M army compromising the "barren-pad" concept of criteria item L8.

Technology Requirement:

Mobile crane capability at KSC is historically and operationally well established, possesses excellent safety record, is highly reliable, and flexible, and falsely underrated for operational use. Vehicle, payload, and passenger support using some form of mobile crane-adapted system should be considered to retain "barren-pad" concept.

Technology References:

This document. See L8 "Conclusions" for potential headcount reduction associated with this criterion.

No: L8.5 **Title:** Simplified Holddown/release

Operations Requirement:

Greatly simplify vehicle holddown systems at pad.

Rationale:

Holddown system of some kind is presently considered mandatory to restrain vehicle in high winds and to stabilize motion during engine start. Existing mechanism incorporates hazardous systems, is costly, time-consuming, and not mandatory for a MPS designed to verify Pc OK characteristics during a "slow rolling" start.

Sample Concept:

Eliminate explosive aspect of bolts, and ultra-high bolt torqueing. Nitinol mechanisms hold promise of holddown/release systems having no pyrotechnics or moving-linkage mechanisms.

Technology Requirement:

Innovative holddown and release mechanism using Nitinol technology/mechanism development or equal.

Critically reevaluate contemporary, stringent holddown and release criteria.

Technology References:

This document. See L8 "Conclusions" for potential headcount reduction associated with this criterion.

No: L8.6 **Title:** No Deluge or Sound Suppression Water

Operations Requirement:

Eliminate very extensive facilities, personnel, test and checkout procedures, and costly O&M of pad water systems.

Rationale:

Gross simplification of launch pad facilities and operations is essential to reduce repetitve cost-to-orbit by factor of 10.

Sample Concept:

Proposed pad has no towers or access structures other than lightning-arrest and light tower(s).

Firex/deluge water necessary to protect swing arm hydraulics, propellants, pneumatics, electrical cabinets and tower/MLP deck are all eliminated by the "barren pad" concept.

Sound suppression water of the STS system is necessary to protect the launch vehicle from the low frequency, high energy acoustics generated by the SRBs.

Technology Requirement:

None.

Technology References:

This document. See L8 "Conclusions" for potential headcount reduction associated with this criterion.

No: L8.7 **Title:** No Pad ECS

Operations Requirement:

Delete extensive costly equipment and personnel providing internal pad structures GN2 purge and pre-launch pressurization. Delete similar systems providing vehicle ECS.

Rationale:

A sizable "town" of facilities, systems, GSE, and personnel inhabit contemporary launch pads. These are costly in O&M personnel and test/checkout/pre-launch validation time, and are not necessary in the proposed "barren pad".

Sample Concept:

No vehicle on-board work is done at the pad other than erection, propellant loading and communications/ controls connect/ positioning. Therefore, no ground-provided vehicle ECS is required. Payload canister is autonomous (manned or unmanned).

Proposed pad blast area does not include offices, shops, restrooms, or routinely occupied areas; only propellant lines, communications/controls and hold-down/umbilical access tunnels and lightning/light tower(s).

Technology Requirement:

None.

Technology References:

This document. See L8 "Conclusions" for potential headcount reduction associated with this criterion.

No: L9 **Title:** Erect/Mate Stages at Pad

Operations Requirement:

Eliminate complex rotation, mate, and associated GSE and bridge cranes in VAB vehicle-mating scenario. Also, eliminate need to transport very large, delicate, awkward assembly to launch pad.

Rationale:

Mating remotely from launch center requires army of men and GSE for complex lifting/rotation harness, bridge cranes, MLP, C/T, platform retraction and the very expensive, labor intensive O&M "tree" necessary to support all this equipment.

Sample Concept:

"Barren Pad" equipped with very simple aft thrust/butt stands on side of flame trench wall. Individual stages rolled relatively quickly to pad on integral landing gear (reusable vehicles), rubber-tired dollies, or rail cars. Individual stages rotated to vertical using large mobile crane with additional winch for vehicle horizontal restraint line. Vehicle "nesting" concept greatly simplifies pad configuration.

One of the prime limitations of mobile crane support is the payload "swinging pendulum" effect which can produce disastrous boom side loads . This same effect is also a serious operational hazard with bridge cranes, e.g., KSC/VAB wherein any initial horizontal translation (acceleration) produces an "overswing" or loss of precision load control. Mobile cranes have been successfully used in place of the MDD to lift orbiters for mate/demate with the SCA on three occasions. Inability to restrain the load pendulum resulted in severe wind-speed limitations during those operations. Rotation about landing gear, single rear-axle dolly, or aft trunion, can retain vehicle ground contact at all times and eliminate the pendulum hazard normally associated with both bridge and mobile cranes.

Any large industrial facility (such as a major launch center) routinely requires large mobile crane support for a multitude of logistics and O&M tasks. Using such a system (carefully selected for capability) for vehicle erection at the launch center is like acquiring an erection system virtually for "free".

Further simplification can result from booster/orbiter auto-mate of clevis-type fittings secured by weight and acceleration forces in place of explosive bolts. Separation can be automatic upon booster shutdown and can be safely controlled by fixed aerodynamic surfaces.

Technology Requirement:

Development only. Note however, this ultra-simple technique requires parallel-mated stages that automatically engage with inter-stage attachment fixtures at termination of the erection sequence, eliminating elevated access structures at the pad.

Technology References:

This document. See following L6, L7, L9 Summary "Conclusions" for potential headcount reduction associated with this criterion.

SHUTTLE EQUIVALENT HEADCOUNT REDUCTION

MOBILE LAUNCHER PLATFORMS (OPERATIONS ORGANIZATION - SPC)

The following describes scope of MLP systems subjected to the usual range of O&M for planned/unplanned/preventive maintenance. Headcount as noted is a potential reduction for simplified transfer and erection.

Skill mix includes certified mechanical and electrical technicians, performing maintenance, support calibrations, modifications, validations, and equipment operation in support of preparing the MLP to support the STS launch schedule. Technician distribution to the 3 MLPs for upcoming launch, follow-on launch, and refurb from latest launch averages 50%, 30%, 20% respectively.

TAIL SERVICE MASTS; 51-L HEADCOUNT = 21; SIMPLIFIED TRANSFER AND ERECTION = 11 (21 LESS 50%): DELETE 10

Maintenance and operation of the LO2 and LH2 TSM systems (including all pneumatic panels that support the T-0 interface), the bonnet and drop weight system and the T-0 carriers.

The average number of PMOMI's is 9/month and the average number of PR's, DR's, and TPS's is 20/month per mobile launcher.

Equivalent systems will be pad-mounted (2 sets) rather than MLP (3 sets). There will be no complex bonnets or drop weights and T-0 carriers will be non-moving, rise-off type with infrared data/control/comm circuits and gravity-powered propellant Q/D and carrier blast covers.

DC POWER; 51-L HEADCOUNT = 17

Maintain, operate, troubleshoot and repair all DC power supplies and "back-up" battery systems in support of all GSE and orbiter power.

The average number of PMOMI's is 11/month and the average number of PR's, DR's, and TPS's is 15/month.

Elimination of MLP DC power is dependent on development of presently unavailable "high density energy cells" enabling enhanced vehicle autonomy.

GROUND HYDRAULICS; 51-L HEADCOUNT = 6

Operation and maintenance of the orbiter/SRB ground hydraulic system in support of vehicle testing and checkout during prelaunch activities.

The average number of PMOMI's is 5/month and the average number of PR's, DR's, and TP's is 11/month.

Elimination of O&M-intense flight hydraulics enables deletion of MLP/pad/ground hydraulic systems.

ORDNANCE; 51-L HEADCOUNT = 3

Installation and removal of ordnance on the T-0 demate devices and the hydrogen preburn igniters.

Perform maintenance and checkout of all GSE pyrotechnic initiator systems (PIC).

The average number of PMOMI's is 3/month and the average number of PR's, DR's, and TPS's is 5/month.

Headcount deletion dependent on elimination of conventional T-0 holddown ordnance and innovative MPS start cycle.

ENVIRONMENTAL CONTROL SYSTEM (ECS)/PORTABLE PURGE UNIT (PPU); 51-L HEADCOUNT = 4

Maintenance, operation and troubleshooting of the ECS system in support of vehicle operations in the VAB, during transportation of the STS to the launch pad and through STS testing and launch.

The average number of PMOMI's is 9/month and the average number of PR's, DR's, and TPS's is 11/month.

Elimination of ground-provided ECS and purge is dependent on innovative vehicle and payload autonomy.

HAZARDOUS GAS DETECTION SYSTEM (HGDS)/GH2 FIRE DETECTION/LEAK DETECTION SYSTEMS; 51-L HEADCOUNT = 12

Operation and maintenance of the HGDS, which requires knowledge of electronics, pneumatic and mechanical systems.

System is operational from validation of the orbiter/launch pad throughout testing, launch and post launch activities.

The average number of PMOMI's is 13/month and the average number of PR's, DR's, and TPS's is 13/month.

Pad located equivalent systems included in necessary headcount elsewhere (L8).

MANAGEMENT; 51-L HEADCOUNT = 13; SIMPLIFIED TRANSFER AND ERECTION = 4 (1 mgr. and 3 shift supervisors for simple mobile dollies/stage transporters): DELETE 9

Supervise/manage MLP technicians including training, certification, safety and administration in support of launch vehicle processing flow schedules.

This function includes the managers and supervisors required to direct operations on three (3) MLP's.

SUPPORT OPERATIONS ORGANIZATION - SPC

The following is an estimation of SPC-equivalent Support Operations headcount reduction enabled by replacing CTs and MLPs with simpler dolly-style mobile transporters and prime movers of a concept similar to Saturn-Apollo S-1C, S-II, etc. (liquid propellant expendable vehicles assumed). This is in addition to the MLP operations functions presented above.

C/T, MLP, PAD STRUCTURES; 51-L HEADCOUNT = 51: DELETE 34

51-L headcount breakdown: pad structures -3 (addressed in L8); remnant divided 24-24 between C/T and MLP support. C/T support is replaced by rubber-tired prime mover and addressed in Heavy Equipment below. MLP support (2 ea. circa 51-L) is reduced by simplicity of mobile transporters. A quantity of 6 ea. is envisioned; 4 ea./booster stages (2 cycles) and 2 ea/core stages (2 cycles). Transporter support headcount estimated at 14 (2 shift supervisors and 12 technicians).

HEAVY EQUIPMENT: ADD 19

Additional heacount is necessary for:
- o Prime mover O&M (2 ea.); headcount required:
  - 3 drivers, 8 observer/techs (2 shift normal coverage)
- o Mobile crane stage rotation operations
  - 2 crane operators, 4 hook tenders, 2 mech. techs.

CRANES/DOORS/PLATFORMS/ELEVATORS; 51-L HEADCOUNT = 90: DELETE 44

C/D/P/E SPC EQUIPMENT; 51-L

o Cranes and hoists	115 devices from 1 to 250-ton capacity
o Mate-demate devices at KSC and DFRF	
o Power doors	55 rollup 24 vertical lift 12 horizontal
o VAB and RPSF work platforms	462 platforms total 236 power operated with remainder manual
o OPF orbiter floor lifts	3 per OPF bay
o Elevators	38 elevators from 3-floor office elevators to VAB and pad high rise elevators

VAB-type bridge cranes for stage rotation/high lift/mate operations not required for horizontal processing. Extensive VAB vertical doors, high bay platforms, and high bay elevators also not required.

Similar cranes/doors/platforms/elevators support for a simplified, horizontally processed liquid propellant vehicle will exist at a stage final assembly/test and checkout facility near the launch site. Support might be incorporated in a combination manufacturing and checkout facility, but for the purposes of this study comparison, is charged to ground processing.

It is presumed that a horizontal test and checkout facility capable of handling two boosters, one core, and cargo loading, would require less than half the quantity of systems noted above. The following headcount results:

Cranes/doors/platforms headcount = 79 x .5 = 40
Elevators headcount = 11 x .5 = 6

ESTIMATE OF ADDITIONAL FACILITIES O&M HEADCOUNT REDUCTION ENABLED BY C/T AND MLP ELIMINATION

o Low voltage electrical	59 x .05 = 3
o Pneumatics	29 x .07 = 2
o HVAC/ECS	49 x .08 = 4
o Industrial water	37 x .08 = 3
o Mechanical shops (fab, mod, refurb)	
- Mechanical	81 x .07 = 6
- Electrical/electronic	29 x .07 = 2
- Chemical sample/analysis	17 x .0 = 0
Total:	20

Conclusions:

Replacing C/Ts and MLPs with mobile dollies and prime movers in a horizontal processing and transfer scenario holds the potential to decrease "STS equivalent" operations and facilities headcount by 79 people; not including QA, safety and the support infrastructure.

The Phase 3 Addendum to Phase 2 Final Report, "51-L Work Volume Indicators", dated Sept. 30, 1988, (page 3) shows the SPC skill mix includes 32.1% "untabulated administrative" (QA, safety, secretarial, analysts, clerks, security, business, human resources, etc.). Applying that ratio to the 79 heads above provides a conservative additional reduction of 79 x .32 = 25; for a total potential headcount reduction of 104 people.

No: L10 **Title:** Payloads: Standard Autonomous Cargo Container

Operations Requirement:

Provide only simple mechanical interface between launch vehicle and payload.

Rationale:

Orbiter payload bay modifications and payload flight support equipment software modifications are among the most time consuming ground support operations.

Sample Concept:

Develop a payload bay module consisting of orbiter-universal strongback and environmental cover (as needed) that has internal capability to support payload electrical, environmental, and communications requirements from loading until orbital placement. This philosophy is also applicable to man-carrying orbital delivery module with life support systems. Concept is dependent upon forcing payload designers to accommodate the launch vehicle rather than vice-versa.

Concept is equally essential to future expendable vehicle configurations. The next generation launch vehicle must become no more than a delivery truck, rather than an environmental Mother Goose.

Technology Requirement:

Longer-life, more reliable (high density) fuel cells or other electrical power source to support payload module. (See E1).

Technology References:

NASA/RECON: 86A14382, 84A11721, 78A51985, 76N27347

See also E1.

86A14382* #ISSUE 3 PAGE 252 CATEGORY 16 RPT#: AIAA PAPER 85-6082 85/00/00 6 PAGES UNCLASSIFIED DOCUMENT COPYRIGHT

UTTL: Guidelines for structural verification and fracture control of Shuttle payloads

AUTH: A/LIFER, C. E.; B/LOU, M. C.

PAA: B/(California Institute of Technology, Jet Propulsion Laboratory, Pasadena)

CORP: Jet Propulsion Lab., California Inst. of Tech., Pasadena.

CIO: UNITED STATES

IN: Shuttle Environment and Operations II Conference, Houston, TX, November 13-15, 1985, Technical Papers (A86-14376 03-16). New York, AIAA, 1985, p. 42-47.

MAJS: / *AEROSPACE SAFETY/ *CRACKING (FRACTURING)/ *SAFETY FACTORS/ *SPACE SHUTTLE PAYLOADS

MINS: / FRACTURE MECHANICS/ NONDESTRUCTIVE TESTS/ REQUIREMENTS

ABA: I.S.

ABS: The procedures followed by the NASA Office of the Chief Engineer in developing the guidelines concerning the structures, materials, and fracture control of the Space Shuttle payloads are described. Factors controlling the payload launch safety, such as crew and passenger safety, reusability, and mixes of payloads in a single launch are emphasized. Special consideration is given to the STS design and testing approaches, materials considerations, safety criticality review processes, nondestructive evaluation inspection for STS payload fracture control, fracture mechanics screening procedures, and components of special concern (e.g., pressurized vessels, fasteners, and composite structures).

....

84A11721*# ISSUE 2 PAGE 135 CATEGORY 12 RPT#: IAF PAPER 83-29 83/10/00 6 PAGES UNCLASSIFIED DOCUMENT

UTTL: The space station - An overview of the design process

AUTH: A/COVINGTON, C.

PAA: A/(NASA, Johnson Space Center, Space Station Project Office, Houston, TX)

CORP: National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

CIO: UNITED STATES International Astronautical Federation, International Astronautical Congress, 34th, Budapest, Hungary, Oct. 10-15, 1983. 6 p.

MAJS: / *DESIGN ANALYSIS/ *NASA PROGRAMS/ *SPACE STATIONS/ *SPACECRAFT DESIGN

MINS: / DATA MANAGEMENT/ HABITABILITY/ SPACECRAFT COMMUNICATION/ SPACECRAFT POWER SUPPLIES/ SPACECRAFT PROPULSION/ SPACECRAFT RELIABILITY/ SPACECRAFT TRACKING/ STRUCTURAL DESIGN/ SYSTEMS ENGINEERING

ABA: D.G.

ABS: The design factors being considered in the NASA space-station development program are summarized. The currently envisioned mission requirements are listed, and the system architecture is defined as a core station, mission-dedicated elements, and supporting equipment such as an orbit maneuvering vehicle. System design factors discussed include orbit selection, contamination control, autonomy, system safety, technology implementation, long life, reliability and maintainability, and cost; subsystem design factors include structural considerations, electrical power, environmental control and life support, data management, communications and tracking, onboard propulsion, habitability, and crew support. Configurational design is seen as driven by a number of factors, primarily the need to fit all components into the Shuttle payload bay for assembly in LEO by the Shuttle crew.

....

78A51985# ISSUE 23 PAGE 4145 CATEGORY 16 RPT#: AIAA PAPER 78-1656 78/09/00 8 PAGES UNCLASSIFIED DOCUMENT COPYRIGHT

UTTL: Space Shuttle vehicle growth options

AUTH: A/BELL, M. W. J.

PAA: A/(Rockwell International Corp., Shuttle Orbiter Div., Downey, Calif.)

CIO: UNITED STATES American Institute of Aeronautics and Astronautics, Conference on Large Space Platforms: Future Needs and Capabilities, Los Angeles, Calif., Sept. 27-29, 1978, 8 p.

MAJS: / *SPACE SHUTTLE PAYLOADS/ *SPACE SHUTTLES/ *SPACECRAFT DESIGN/ *TECHNOLOGY ASSESSMENT

MINS: / FUEL TANKS/ HEAVY LIFT LAUNCH VEHICLES/ MANNED SPACE FLIGHT/ MISSION PLANNING/ REUSABLE LAUNCH VEHICLES/ SPACE SHUTTLE BOOSTERS/ SPACE TRANSPORTATION

ABA: G.R.

ABS: Advanced space mission conceptual studies conducted during the past five years reveal potential operational space transportation requirements beyond those of the present Space Shuttle System. There will be requirements for increased payload delivery weight and volume, increased launch rate, increased crew size and passenger delivery, increased mission duration, increased electrical power, and increased waste heat collection and rejection in connection with potential future missions currently being considered. Increased payload weight options are examined, taking into account an external tank solid rocket motor strap-on concept, liquid-propellant rocket booster designs, and an advanced shuttle configuration concept. Attention is also given to a heavy lift launch vehicle, an extended-duration mission orbiter, an orbiter passenger transport, aspects of large diameter payload delivery, a 'stretched' orbiter concept, and problems of high-energy orbit payload delivery.

....

76N27347# ISSUE 18 PAGE 2305 CATEGORY 18 RPT#: DLR-IB-552-75/19 75/00/00 76 PAGES In GERMAN UNCLASSIFIED DOCUMENT DCAF E002631

UTTL: Ariane passenger of the DFVLR. Draft study

AUTH: A/PIETRASS, A.; B/PULS, J.

CORP: Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany).

CSS: (Inst. fuer Dynamik der Flugsysteme.) AVAIL.NTIS

SAP: HC $5.00

CIO: GERMANY, FEDERAL REPUBLIC OF

MAJS: / *ARIANE LAUNCH VEHICLE/ *MISSION PLANNING/ *PAYLOADS/ *SATELLITE-BORNE INSTRUMENTS

MINS: / PLASMA PAUSE/ SATELLITE ATTITUDE CONTROL/ SATELLITE CONFIGURATIONS/ STAR TRACKERS/ ULTRAVIOLET RADIATION

ABA: ESA

ABS: A proposal is made for an Ariane launch vehicle payload satellite containing technological and scientific experiments. Technological experiments proposed are: a three axis altitude system, a star field sensor, an ion direction sensor, an RF position sensor, time measurement equipment, a hydrazine propulsion unit, and a modular telemetrytelecommand system. Scientific experiments are: measurement of the geocoronal and interplanetary scattered radiation in the UV and investigation of the plasmapause. The configuration of the passenger satellite is detailed, and a mission plan described.

....

TABLE OF CONTENTS

PAGE 308 INTENTIONALLY BLANK

ACRONYMS and ABBREVIATIONS

APCI	Air Products & Chemicals, Inc.
APU	Auxiliary Power Unit
ARF	(SRB) Assembly and Refurbishment Facility
ASTF	Aft Skirt Test Facility
BAir	Breathing air
Big Three	Big Three Industries, Inc.
BOC	Base Operations Contract(or)
C-39	Complex 39
CCF-39	Complex 39 Converter/Compressor Facility
Cryoload	Cryogenic loading
DFRF	Dryden Flight Research Facility
DRL	Data Requirements List
EG&G	EG&G Florida, Inc.
EPS	Electrical Power Subsystem
ESA	Explosive Safe Area
ET	External Tank
FCSS	Fuel cell servicing system
FRF	Flight readiness firing
FSS	Fixed service structure
FTAT	Fire Training Area Tank
GH2	Gaseous hydrogen
GHe	Gaseous helium
GN2	Gaseous nitrogen
GO2 F	High purity gaseous oxygen
HMF	Hypergol Maintenance Facility (OMS/RCS Processing Area; ORPA)
HPI	Hypergol Propellants Incinerator
HPU	Hydraulic power unit
Hyperload	Hypergolic loading
IPA	Isopropyl alcohol
KSC	John F. Kennedy Space Center
LC-39	Launch Complex 39
LCD	Launch Countdown
LH2	Liquid hydrogen
LO2 A	Propellant-grade liquid oxygen
LO2 F	High-purity liquid oxygen
MMH	Monomethyl hydrazine
MON	Mixed oxides of nitrogen
N/F	Not forecasted
N2H4	Monopropellant-grade hydrazine
N2O4	Nitrogen tetroxide
NaOH-25	25-Percent sodium hydroxide
NASA	National Aeronautics and Space Administration
NH3	Ammonia

ACRONYMS and ABBREVIATIONS
(Continued)

OMS	Orbital Maneuvering System
OPF	Orbiter Processing Facility
ORPA	OMS/RCS Processing Area (previously HMF)
PDU	Portable deionizing unit
PDT	Pacific Daylight Time
PHSF	Payload Hazardous Servicing Facility
ppm	Part(s) per million
PRSD	Power reactant supply and distribution system
psig	Pound(s) per square inch gage
QD	Quick disconnect
R-21	Refrigerant 21
RCS	Reaction control system
RSV	Ready storage vessel
RTLS	Return to launch site
SAEF II	Spacecraft Assembly and Encapsulation Facility
scf	Standard cubic feet
scfm	Standard cubic feet per minute
SRB	Solid Rocket Booster
STS	Space Transportation System
TBD	To be Determined/Defined
TDRS	Tracking and Data Relay Satellite
TPS	Thermal Protection System
TVC	Thrust Vector Control
VAB	Vehicle Assembly Building
WCDDT	(Wet) Countdown Demonstration Test

STS-26R FLUIDS CONSUMPTION AND COST DATA

1.0 INTRODUCTION

1.1 GENERAL

This report has been prepared as a supplement to the ALS Phase 2 contractor work shops to be conducted by the SGOE/T Study team. It is intended to assist designers of future launch vehicle systems with quantified data as a baseline for fluids consumption and cost relative to handling and boiloff losses and significant waste product generation. The data are extracted from the propellants/presurrants support report provided by EG&G Technical Operations, EGG-630, during checkout and launch of the STS-26R vehicle. This launch was the first return-to-flight mission occurring since the loss of mission 51-L.

1.2 SCOPE

This data summarizes support provided for STS-26R from arrival at LC-39B thru FRF, VCDDT and launch, and encompasses the following categories:

- o Propellants/Pressurants Support
- o Cargo Support
- o Hazardous Waste Support

Data for life support services and KSC landing support are not included herein.

1.3 VEHICLE PROCESSING

Vehicle processing was initiated with rollout to LC-39B on July 4, 1988 and included two FRF attempts and two WCDDT's. Launch occurred on the initial attempt at 1137 hours, Thursday, September 29, 1988 after a 1-hour and 38-minute delay in the countdown due to upper atmosphere low-wind conditions.

1.4 CHRONOLOGY

The following chronology presents the major test events requiring support during the processing of STS-26R.

- o S0024 PRELAUNCH PROPELLANT LOAD - 7/10/88 - 7/13/88
- o V2303 FCSS/PRSD DEWAR SERVICING - 7/18/88
- o S0014 FRF - 7/24/88 - 8/11/88

  7/24/88 - Call to stations at 2330 hours

  WCDDT - 7/28/88 - 8/01/88

  7/28/88 - Scrubbed due to LH2 QD and LO2 A pump problems

  7/31/88 - Second attempt initiated with successful completion at 0700 hours, 8/01/88

1.4 (Continued)

8/04/88 - Initial FRF attempt scrubbed due to faulty engine valve.

8/10/88 - Successful FRF at 0730 hours

8/11/88 - Completed pad/vehicle safing

- S0024 PRELAUNCH PROPELLANT LOAD - 8/24/88 - 8/25/88
- V2303 FCSS/PRSD DEWAR SERVICING - 9/18/88
- S0007 LCD - 9/26/88 - 9/29/88

9/26/88 - Call to Stations at 0800 hours

9/29/88 - Launch*

* Included an unscheduled 1-hour, 38-minute hold.

2.0 PROPELLANTS/PRESSURANTS SUPPORT

2.1 LH2 (PROPELLANT)

2.1.1 General. Total propellant LH2 consumption for processing and launch of STS-26R was 805,000 gallons. For reference, volume of the shuttle external LH2 tank is 415,585 gallons.

2.1.2 Test Support. The following quantities of LH2 were consumed for each major test event. NOTE: Data for the two WCDDT's are combined.

EVENT	GALLONS
Combined WCDDT's	100,000
FRF (first attempt)	105,000
FRF (second attempt)	100,000
LCD/Launch	500,000
TOTAL Propellant LH2 Consumption	805,000

- Post-Launch Inventory, LC-39B = 310,000 gallons

2.1.3 Departures/Deviations from Planned Support. The following deviations from planned propellant LH2 support were incurred during STS-26R pre-launch processing.

- During WCDDT attempts (7/28/88 through 8/1/88), the A126 and A127 L02 pumps would not start (~0100, 7/29/88) causing a 72-hour scrub/turnaround. Refill was resumed at 2145 hours, 7/31/88 and the second WCDDT was completed at 0713 hours, 8/1/88. An LH2 QD leak at the ET umbilical was experienced during the second WCDDT.
- During FRF, on 8/4/88, an automatic abort due to software anomalies occurred at T-5 (0730 hours) resulting in an LH2/L02 A drainback.
- The launch consumption was 26,000 gallons above the expected consumption of 474,000 gallons. NOTE: The readability of the sphere liquid level gage is only precise to +/- 9,000 gallons.

2.2 LH2 (FUEL CELL)

2.2.1 General. Total LH2 provided for FCSS/PRSD dewar servicing for STS-26R was 5,600 gallons. For reference, the EPS includes three LH2 dewars containing a total of 276 lb. LH2 (466 gallons).

2.2.2 Test Support. Two FCSS/PRSD dewar servicing operations were performed in support of STS-26R as follows.

EVENT	GALLONS
COMBINED WCDDT's	2,900
LCD/Launch	2,700
Total Fuel Cell LH2 Provided	5,600

No deviations from planned support were incurred.

2.3 GH2

2.3.1 General. A total of 92,248 scf of GH2 were consumed during processing and launch of STS-26R.

2.3.2 Test Support. The following data provides battery pressure readings before and after the events listed and the total GH2 usage. NOTE: Data are not available to provide a breakout of WCDDT usage from total FRF usage.

EVENT	GH2 BATTERY PRESSURE INITIAL (PSIG)	GH2 BATTERY PRESSURE FINAL (PSIG)	USAGE (SCF)
WCDDT's, FRF --	4200	2800	73,603
LCD/Launch	4000	3700	18,645
TOTAL GH2 Battery Usage			92,248

2.3.3 Departures/Deviations from Planned Support. Sampling of the GH2 battery after prelaunch servicing on 9/09/88 indicated contamination of 56- to 80-ppm helium requiring battery blowdown and burnoff to 200 psig. A second servicing was performed on 9/18/88 and the battery sampled within specification/ready for launch.

2.4 LO2 A (PROPELLANT-GRADE)

2.4.1 General. Total propellant LO2 A consumption for processing and launch of STS-26R was 740,000 gallons.

2.4.2 Test Support. The following quantities of LO2 A were consumed for each major test event. NOTE: Data for the two WCDDT's are combined. For reference, volume of the shuttle external LO2 tank is 145,800 gallons.

EVENT	GALLONS
Combined WCDDT's	210,000
FRF (first attempt)	130,000
FRF (second attempt)	138,000
LCD/Launch	262,000
Total LO2 A Consumption	740,000

o Post-Launch Inventory, LC-39B = 262,000 gallons

2.4.3 Departures/Deviations from Planned Support. The following deviations from planned propellant LO2 A support were incurred during STS-26R pre-launch processing.

o During WCDDT attempts (7/28/88 through 8/1/88), the A126 and A127 LO2 pumps would not start (~0100, 7/29/88) causing a 72-hour scrub/turnaround. Refill was resumed at 2145 hours, 7/31/88 and the second WCDDT was completed at 0713 hours, 8/1/88. An LH2 QD leak at the ET umbilical was experienced during the second WCDDT.

o During FRF, on 8/4/88, an automatic abort due to software anomalies occurred at T-5 (0730 hours) resulting in an LH2/LO2 A drainback.

o The launch consumption was 34,000 gallons above the expected consumption of 228,000 gallons. NOTE: The readability of the sphere liquid level gage is only precise to +/- 9,000 gallons.

2.5 LO2 F (FUEL CELL, HIGH PURITY)

2.5.1 General. Total LO2F provided for FCSS/PRSD dewar servicing for STS-26R was 1,859 gallons. For reference, the EPS includes three LO2 dewars containing a total of 2,343 lb. LO2 (246 gallons). 168 lb. of the LO2 are for ECLSS.

2.5.2 Test Support. Two FCSS/PRSD dewar servicing operations were performed in support of STS-26R as follows.

EVENT	GALLONS
COMBINED WCDDT's	937
LCD/Launch	922
Total Fuel Cell LH2 Provided	1,859

No deviations from planned support were incurred.

2.6 GO2 F (FUELCELL, HIGH PURITY)

2.6.1 General. A total of 43,979 scf of GO2 F were consumed during processing and launch of STS-26R.

2.6.2 Test Support. The following data provides battery pressure readings before and after the events listed and the total GO2 F usage.

EVENT	GO2 F BATTERY PRESSURE INITIAL (PSIG)	FINAL (PSIG)	USAGE (SCF)
WCDDT's	4,900	4,100	17,554
FRF	5,600	4,800	19,701
LCD/Launch	4,800	4,480	6,724
	TOTAL GO2 F Battery Usage		43,979

No deviations from planned support were incurred.

2.7 GN2

2.7.1 General. The C-39 GN2 system supported processing and launch of STS-26R, including two FRF attempts and two WCDDT's. Nominal daily uses for other C-39 facilities are subtracted from the C-39 Meter Station GN2 totalizer readings which provide the following reported usages.

2.7.2 Test Support. The GN2 flow rates for the following tests were obtained from continuous flow charts and readings taken at regular intervals at the C-39 Meter Station.

- V1040 Orbiter PRSD Load

  The two Orbiter PRSD loads were accomplished essentially as planned with nominal average flow rates of 7,000 scfm.

o S0014 FRF

GN2 flows for the two WCDDT's and the two FRF attempts were essentially as planned with peak flow rates of 16,000 scfm experienced. Total GN2 usage for each WCDDT and FRF attempt was slightly higher than planned due to extended purge requirements after drainback.

o S0007 LCD

GN2 flows for LCD were essentially as planned. Total usage for each STS-26R major event were as follows:

EVENT	DURATION (DAYS)	USAGE NOMINAL (SCF)	ACTUAL (SCF)
WCDDT (1st Attempt)	4	17,000,000	17,500,000
WCDDT (2nd Attempt)	3	17,000,000	19,000,000
FRF (1st Attempt)	4	18,000,000	19,000,000
FRF (Successful)	3	17,000,000	19,000,000
LCD	3	12,000,000	12,000,000

No significant deviations from planned support were incurred.

2.8 GHe

2.8.1 General. The mode of GHe support for STS-26R during processing and launch, including two FRF attempts and two WCDDT's, was essentially as planned.

2.8.2 Test Support. It should be noted that there are no flow recorders for GHe. To obtain the following consumption data, battery pressure decay and Joy compressor runtimes were recorded at regular intervals from which consumption data were calculated. Nominal daily usage for other C-39 facilities were subtracted from calculated totals yielding the following usage.

o S0014 FRF

Total GHe usage for each WCDDT/FRF attempt was somewhat higher than expected due to extended purging at the end of each test. Bureau of Mines compressed gas trailers were shipped to KSC to augment railcar support during S0014 due to the higher usage and two additional vehicle tankings required.

o S0007 LCD

Total GHe usage for LCD was nominal for the 3-day period (1-hour, 37-minute unscheduled holdtime was considered in calculating the usage).

Total GHe usage for each event is presented in the following matrix:

EVENT	DURATION (DAYS)	USAGE NOMINAL (SCF)	USAGE ACTUAL (SCF)
WCDDT (1st Attempt)	4	1,500,000	1,800,000
WCDDT (2nd Attempt)	3	1,300,000	1,900,000
FRF (1st Attempt)	4	1,500,000	2,000,000
FRF (Successful)	3	1,300,000	1,900,000
LCD	3	900,000	900,000

2.9 HYPERGOLS

2.9.1 General. Hypergols required for launch of STS-26R were MMH, N204 MON-3 and N2H4. The LC-39B MMH and N204 RSV's did not require replenishment prior to LCD; however, a total of 256 gallons of N2H4 was provided. the following hypergol system volumes are included for reference:

	N204 lb.	N204 gallons	MMH lb.	MMH gallons
OMS Basic Kit, 1000 fps (2 pods total)	14,866	1,244	9,010	1,236
RCS Aft (2 pods total)	2,976	249	1,860	255
Forward	1,488	125	930	128
TOTAL		1,618		1,619

2.9.2 Test Support. The APU/HPU servicing carts were filled in support of STS-26R as follows:

REQUIREMENT	DATE	GALLONS
APU Cart Loading	6/15/88	216
HPU Cart Loading	7/07/88	40

Hypergol launch consumption and post-launch inventory levels are presented in the following. NOTE: All quantities are expressed in gallons.

			POST LAUNCH INVENTORY		
HYPERGOL	LC-39B PRE-S0024	ONBOARD LOAD	LC-39B	FUEL STORAGE AREA 1	LC-39A
MMH	7,500	1,060	6,400*	-0-	5,660
N204 MON-3	3,160	1,060	2,100**	2,375	6,500
N2H4	-	120	-	1,320	-

* Not verified
** Calculated based on tank level

2.9.3 Departures/Deviations from Planned Support. No deviations from planned support were incurred; however, during the performance of S0024 it was determined that the LC-39B liquid level gages were not calibrated correctly and previous RSV level readings were inaccurate; therefore, the N204 RSV level was "marginal" for Hyperload. The amount of N204 required in the system piping and the RSV is being recalculated by LSOC personnel to establish a new minimum quantity (if necessary); the present minimum is 3,000 gallons.

2.10 TOXIC VAPOR SCRUBBER SOLUTIONS

2.10.1 General. Citric acid and NaOH-25 are used as scrubber solutions for the fuel and oxidizers scrubbers (respectively).

2.10.2 Test Support. Scrubber changeouts are performed on an "as requested" basis. The following quantities were provided in support of STS-26R.

- Citric Acid (Fuel Scrubbers)

  ARF - 2,250 pounds
  HMF - 255 pounds
  C-39B - 950 pounds

- NaOH-25

  LC-39B - 660 gallons

2.11 R-21

There were 533 pounds of R-21 consumed in support of STS-26R. Current inventory levels are 17,000 pounds contained in 1,000-pound cylinders and 1,650 pounds in 150-pound cylinders. No deviations to planned support were incurred.

2.12 DEIONIZED WATER

PDU'S were maintained in "ready" condition for support of STS-26R. Units 1, 2 and 3 were utilized in the OPF and Unit 4 was assigned to the O&C. Unit 5 was maintained on "backup" status for emergency use if required. No deviations to planned support were incurred.

2.13 NH3

There were approximately 100 pounds of NH3 consumed in support of STS-26R. Current inventory level is 650 pounds. No deviations to planned support were incurred.

3.0 CARGO SUPPORT

The following propellants/pressurants were provided in support of the TDRS payload deployed from STS-26R.

- o N2H4 .... 1,590 pounds (4 drums)
- o BAir .... 876 scf (4 K-bottles)
  52,218 scf (1 compressed gas trailer)
- o GN2 .... 440 scf (2 K-bottles)

4.0 HAZARDOUS WASTE SUPPORT

The following matrix presents only significant quantities of hazardous waste generated during processing and launch of STS-26R, including FRF and WCDDT support. Wastes volumes generated were not significantly greater than expected. The list of potential contaminants exceeds 50 line items.

LOCATION/ FACILITY	GENERATING PROCESS	WASTE COMPOSITION/TYPE WITH PROCESS CODE	DISPOSAL SITE/PROCESS	QUANTITIES* FORECAST	ACTUAL
ARF (L6-248)	SREI TPS Application	Solids KUB-NMS-L6248	Complex 13/ Offsite	50	82
		Solvents	K7-165/ Offsite	N/F	17
Fuel Storage Area 1 (Facility 80500)	Dump and Flush of Oxidizer-Contaminated Components	Corrosive Liquid KGG-HOD-80520	Tanker/ Offsite	500**	100**
C-39B	Oxidizer Farm (RSV) Scrubber Changeout	NaOH-25 KLH-HOC-J7490	Tanker/ Offsite	1000**	800**
	FSS Oxidizer Scrubber Changeout	NaOH-25 KLH-HOC-J7337	Tanker/ Offsite	1000**	200**
	Fuel Farm (RSV) Scrubber Changeout	Spent Citric Acid KLH-NFF-J7534	HPI	300**	800**
	FSS Fuel Scrubber Changeout	Spent Citric Acid KLH-NFF-J7337	HPI	300**	200**
	Fuel Farm Sump	Water with Slight Amount of MMH KLH-HFH-J7534	HPI/ Offsite	100**	75**

NOTE: * All quantities are in drums unless indicated as ** (gallons)

5.0 FLUIDS COST DATA

The following KSC cost data were effective May, 1988.

LN2	$ 90.00/ton
L02A	55.00/ton
L02F	264.00/ton
GN2	4.00/MSCF
GHE	64.00/MSCF
N204	2.75/lb.
N2H4	10.00/lb.
MMH	10.00/lb.
H202 (90 %)	3.20/lb.
LHE	3.65/Li (D) $2.75 (bulk)
RP-1	3.00/gal
JP-5	1.42/gal

NASA
National Aeronautics and Space Administration

Report Documentation Page

p. 322

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.

4. Title and Subtitle

Shuttle Ground Operations Efficiencies/Technologies Study - Phase 3

Volume 3 of 4, ALS Phase 2 Contractor Workshop Data Reference Document - Simplified Launch System Operational Criteria

5. Report Date

May 1989

6. Performing Organization Code

-

7. Author(s)

A/ Scholz, A.L.; B/ Byrd, R.J.

8. Performing Organization Report No.

None

10. Work Unit No.

N/A

9. Performing Organization Name and Address

Boeing Aerospace Operations
Cocoa Beach, FL

11. Contract or Grant No.

NAS10-11344

13. Type of Report and Period Covered

Final 6/88-5/89

12. Sponsoring Agency Name and Address

Department of the Air Force - HQ Space Division (AFSC)
Los Angeles AFB, P.O. Box 92960
Los Angeles, CA 90009-2960
Administered by NASA John F. Kennedy Space Center, FL

14. Sponsoring Agency Code

15. Supplementary Notes

This document is phase 3 of a 3-phase study. Phase 1 has been published as NASA CR-180581 thru 180585.

16. Abstract

This SLSOC volume identifies 61 items which drive operations schedules and cost. Each item is explained relative to: 1) Operations Requirement; the perceived/experienced need for improvement or change, 2) Rationale; for its impact on operations; 3) Sample Concept; "free thinking" example with intent to inspire designers to search for other than "business as usual" solutions; 4) Technology Requirement; in those cases where enabling knowledge and hardware are apparent; and 5) Technology References; NASA RECON technical report references related to the topic. The SLSOC are categorized: 1) Management and System Engineering, 2) Avionics and Software; 3) Power; 4) Structures and Materials; 5) Propulsion; and 6) Facilities and Support Equipment.

Solutions /Sample Concepts to the problems are posed to stimulate a "new look" at old concepts and to energize the creativity of designers and program personnel with the admonition to dramatically simplify systems and operations in all areas.

17. Key Words (Suggested by Author(s))

Cost benefit analysis
ground operations
management analysis
Space Transportation System
technology assessment

18. Distribution Statement

Unclassified - Unlimited

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of pages	22. Price
Unclassified	Unclassified	321	